STANDARD

APPLICATION FOR A CERTIFICATE OF CONVENIENCE

AND

NECESSITY FOR A PROPOSED TRANSMISSION LINE

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Submit seven (7) copies of the application and all attachments supporting the application. If the application is being filed pursuant to 16 Tex. Admin. Code §25.101(b)(3)(D) (TAC) or 16 TAC §25.174, include in the application all direct testimony. The application and other necessary documents shall be submitted to:

Public Utility Commission of Texas
Attn: Filing Clerk
1701 N. Congress Ave.
Austin, Texas 78711-3326

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Note: As used herein, the term "joint application" refers to an application for proposed transmission facilities for which ownership will be divided. All applications for such facilities should be filed jointly by the proposed owners of the facilities.

1. Applicant (Utility) Name:

For joint applications, provide all information for each applicant.

Applicant (Utility) Name:	Oncor Electric Delivery Company LLC ("Oncor")
Certificate Number:	30158
Street Address:	1616 Woodall Rodgers Freeway Dallas, Texas 75202
Mailing Address:	1616 Woodall Rodgers Freeway Dallas, Texas 75202-1234

Applicant (Utility) Name:	AEP Texas Inc. ("AEP Texas")
Certificate Number:	30170[1]
Street Address:	539 North Carancahua Corpus Christi, Texas 78401
Mailing Address:	539 North Carancahua Corpus Christi, Texas 78401

2. Please identify all entities that will hold an ownership interest or an investment interest in the proposed project but which are not subject to the Commission's jurisdiction.

Oncor and AEP Texas will each hold an ownership interest in portions of the Sand Lake – Solstice 345 kV Transmission Line Project ("Proposed Transmission Line Project").

3.

Person to Contact:	Chris Reily, Oncor
Title/Position:	Regulatory Project Manager
Phone Number:	(214) 486-4717
Mailing Address:	1616 Woodall Rodgers Fwy, Suite 6A-012 Dallas, Texas 75202-1234
Email Address:	Chris.Reily@oncor.com

Person to Contact:	Randal E. Roper, AEP Texas
Title/Position:	Regulatory Case Manager – AEP Texas
Phone Number:	(512) 481-4572
Mailing Address:	400 W. 15th Street, Suite 1520 Austin, Texas 78701
Email Address:	reroper@aep.com

[1] Certificate Number 30170 was assigned to AEP Texas North Company, which with AEP Texas Central Company, merged with their immediate parent company AEP Utilities, Inc. effective December 31, 2016. The merger was approved by the Public Utility Commission of Texas on December 1, 2016 in P.U.C. Docket No. 46050; SOAH Docket No. 473-16-4822 — Application of AEP Texas Central Company, AEP Texas North Company, and AEP Utilities, Inc. for Approval of Merger. As of January 2017, the merged company is doing business as AEP Texas Inc.

3a. Legal Counsel – Oncor:

	Jaren A. Taylor
	Winston Skinner
Phone Number:	(214) 220-7754
Mailing Address:	Vinson & Elkins LLP
	Trammell Crow Center
	2001 Ross Avenue, Suite 3700
	Dallas, Texas 75201
Email Address:	jarentaylor@velaw.com

Legal Counsel – AEP Texas:

	Jerry Huerta – AEP Service Corp
Phone Number:	(512) 481-3323
Mailing Address:	400 W. 15th Street, Suite 1520
	Austin, Texas 78701
Email Address:	jnhuerta@aep.com
	Kerry McGrath
Phone Number:	(512) 744-9300
Mailing Address:	Duggins Wren Mann & Romero, LLP
	600 Congress Avenue, 19th Floor
	Austin, Texas 78701
Email Address:	kmcgrath@dwmrlaw.com

Please contact Jaren Taylor with any inquiries regarding the project.

4. Project Description:

Provide a general description of the project, including the design voltage rating (kV), the operating voltage (kV), the CREZ Zone(s) (if any) where the project is located (all or in part), any substations and/or substation reactive compensation constructed as part of the project, and any series elements such as sectionalizing switching devices, series line compensation, etc. For HVDC transmission lines, the converter stations should be considered to be project components and should be addressed in the project description.

If the project will be owned by more than one party, briefly explain the ownership arrangements between the parties and provide a description of the portion(s) that will be owned by each party. Provide a description of the responsibilities of each party for implementing the project (design, Right-Of-Way acquisition, material procurement, construction, etc.).

If applicable, identify and explain any deviation in transmission project components from the original transmission specifications as previously approved by the Commission or recommended by a PURA §39.151 organization.

Name or Designation of Project:	Sand Lake – Solstice 345 kV Transmission Line Project
Design Voltage Rating (kV):	345 kV

Operating Voltage Rating (kV):	345 kV
Normal Peak Operating Current (A):	5138 A (Oncor) 6091 A (AEP Texas)

Oncor and AEP Texas plan to construct the Proposed Transmission Line Project as detailed in the Letter Agreement dated October 5, 2018, which is included as Attachment No. 2. The Proposed Transmission Line Project is a new 345 kilovolt ("kV") double-circuit transmission line connecting Oncor's Sand Lake Switch, located approximately 6 miles northeast of the city of Pecos on the northwest side of Farm-to-Market Road ("FM") 3398 in Ward County, Texas, to the AEP Texas Solstice Switch located along the north side of Interstate Highway ("IH") 10 approximately 2.5 miles east of the Pecos/Reeves County Line in Pecos County, Texas.

Prior to final approval, Oncor and AEP Texas will determine an appropriate location along the approved route for a division of ownership between Oncor and AEP Texas that will generally divide the line in two even parts. Oncor and AEP Texas have agreed that each party will be responsible for their respective portions of the Proposed Transmission Line Project (i.e. design, right-of-way ("ROW") acquisition, material procurement, construction, etc.) with coordination of these activities between the two parties.

The Proposed Transmission Line Project includes the 345 kV additions to Oncor's Sand Lake Switch station and to AEP Texas' Solstice Switch station. The work at these stations may include station dead-end structures, bus work, transformers, grading, fences, and other structures and equipment.

The length of the overall Proposed Transmission Line Project ranges between approximately 44.5 to 58.7 miles, depending on which route is selected by the Public Utility Commission of Texas ("PUCT").

This project shares a common endpoint with the separate Bakersfield – Solstice 345 kV transmission line CCN project concurrently being filed by AEP Texas and the Lower Colorado River Authority Transmission Services Corporation ("LCRA TSC") in Docket No. 48787. Pursuant to PURA § 37.0541, Applicants will seek consolidation of this proceeding with the Bakersfield – Solstice project.

5. Conductor and Structures:

Conductor Size and Type:	1926.9 kcmil ACSS/TW (Oncor) 1590 ACSS (AEP Texas)
Number of conductors per phase:	2
Continuous Summer Static Current Rating (A):	5138 A (Oncor) 6091 A (AEP Texas)
Continuous Summer Static Line Capacity at Operating Voltage (MVA):	3070 MVA (Oncor) 3640 MVA (AEP Texas)
Continuous Summer Static Line Capacity at Design Voltage (MVA):	3070 MVA (Oncor)

	3640 MVA (AEP Texas)
Type and composition of Structures:	Double-Circuit Lattice Steel Tower
Height of Typical Structures:	125 feet (Oncor)*
	165 feet (AEP Texas)*

*This number reflects the approximate visible height of the structure from ground to structure top. Please see the drawing of these typical structures in Figures 1-2 and 1-3, pages 1-7 and 1-8, of the *Environmental Assessment and Alternative Route Analysis for Oncor Electric Delivery Company LLC's and AEP Texas Inc.'s Proposed Sand Lake – Solstice 345 kV Transmission Line Project in Pecos, Reeves and Ward Counties, Texas* ("Environmental Assessment and Routing Study"), prepared by Halff Associates, Inc. ("Halff") and included as Attachment No. 1.

Explain why these structures were selected; include such factors as landowner preference, engineering considerations, and costs comparisons to alternate structures that were considered.

For joint applications, provide and separately identify the above-required information regarding structures for the portion(s) of the project owned by each applicant.

Oncor and AEP Texas selected the double-circuit 345 kV steel lattice tower. The Proposed Transmission Line Project's study area contains numerous factors, detailed in the Environmental Assessment and Routing Study, which affirmed the use of these structures for the Proposed Transmission Line Project. A few of the factors considered were nominal distance between structures (i.e., span length), structure footprint, right-of-way requirements, technical specifications, construction and maintenance issues, cost, impact to affected landowners, the specific characteristics of the study area, and other items.

Provide dimensional drawings of the typical structures to be used in the project.

A drawing of the typical structures are shown in Figures 1-2 and 1-3, pages 1-7 and 1-8, of the Environmental Assessment and Routing Study included as Attachment No. 1.

6. Right-of-way:

For joint applications, provide and separately identify the above-required information for each route for the portion(s) of the project owned by each applicant.

Miles of Right-of-Way	Approximately 44.5 to 58.7 miles
Miles of Circuit	Approximately 89.0 to 117.4 miles
Width of Right-of-Way	Approximately 160 feet
Percent of Right-of-Way Acquired	0%

Provide a brief description of the area traversed by the transmission line. Include a description of the general land uses in the area and the type of terrain crossed by the line.

The project area is located in parts of Pecos, Reeves, and Ward Counties, Texas. The project area includes the incorporated cities of Barstow and Pecos.

The project area generally centers south of the Pecos River in west Texas, south of the New Mexico-Texas state boundary. The majority of the project area consists of rural, undeveloped land used primarily for oil and gas production, livestock grazing, and/or irrigated crop production. The topography is gently sloping towards the Pecos River floodplain, which is wide and flat. The Pecos River and floodplain are oriented northwest to southeast. Vegetation is predominantly shrubland dominated by creosote bush and grassland species. Major roadways in the study area are IH 10, IH 20, US Highway 285 and State Highway ("SH") 17.

Specific discussion regarding natural, human and cultural resources in the project area is set forth in the Environmental Assessment and Routing Study, Sections 3.2 through 3.8, pages 3-1 through 3-82, included as Attachment No. 1.

7. **Substations or Switching Stations:**

List the name of all existing HVDC converter stations, substations or switching stations that will be associated with the new transmission line. Provide documentation showing that the owner(s) of the existing HVDC converter stations, substations and/or switching stations have agreed to the installation of the required project facilities.

Oncor's Sand Lake Switch (currently under development in connection with the Riverton – Sand Lake transmission line previously approved in Docket No. 47368)
AEP Texas' Solstice Switch expanded for an adjacent new 345-kV yard

List the name of all new HVDC converter stations, substations or switching stations that will be associated with the new transmission line. Provide documentation showing that the owner(s) of the new HVDC converter stations, substations and/or switching stations have agreed to the installation of the required project facilities.

None

8. **Estimated Schedule:**

*Estimated Dates of:	Start	Completion
Right-of-way ("ROW") and Land Acquisition**	5/2019(Oncor) 5/2019(AEP Texas)	7/2020(Oncor) 10/2020(AEP Texas)
Engineering and Design	5/2019(Oncor) 5/2019(AEP Texas)	3/2020(Oncor) 12/2019(AEP Texas)
Material and Equipment Procurement	8/2019(Oncor) 6/2019(AEP Texas)	6/2020(Oncor) 2/2020(AEP Texas)
Construction of Facilities	4/2020(Oncor) 1/2020(AEP Texas)	12/2020(Oncor) 12/2020(AEP Texas)
Energize Facilities	12/2020(Oncor) 12/2020(AEP Texas)	12/2020(Oncor) 12/2020(AEP Texas)

* Dates are based on 180 day CCN process due to ERCOT critical designation.
**One or both Applicants may commence ROW discussions with landowners during the pendency of this proceeding.

9. Counties:

For each route, list all counties in which the route is to be constructed.

All routes are located within Pecos, Reeves, and Ward Counties.

10. Municipalities:

For each route, list all municipalities in which the route is to be constructed.

No route is proposed to be constructed within the city limits or extra-territorial jurisdiction ("ETJ") of any municipality.

For each applicant, attach a copy of the franchise, permit or other evidence of the city's consent held by the utility, if necessary or applicable. If franchise, permit, or other evidence of the city's consent has been previously filed, provide only the docket number of the application in which the consent was filed. Each applicant should provide this information only for the portion(s) of the project which will be owned by the applicant.

Not Applicable

11. Affected Utilities:

Identify any other electric utility served by or connected to facilities in this application.

No other electric utility will be served by or connected to the Proposed Transmission Line Project other than the Joint Applicants, Oncor and AEP Texas.

AEP Texas and LCRA TSC are simultaneously filing a CCN application for the Bakersfield to Solstice 345 kV transmission line (Commission Docket No. 48787), which will connect to the Solstice Switch Station.

Describe how any other electric utility will be affected and the extent of the other utilities' involvement in the construction of this project. Include any other electric utilities whose existing facilities will be utilized for the project (vacant circuit positions, ROW, substation sites and/or equipment, etc.) and provide documentation showing that the owner(s) of the existing facilities have agreed to the installation of the required project facilities.

No other electric utility will be involved in the construction of the Proposed Transmission Line Project other than the Joint Applicants. No other utilities' existing facilities will be utilized other than the Joint Applicants' facilities.

12. Financing:

Describe the method of financing this project. For each applicant that is to be reimbursed for all or a portion of this project, identify the source and amount of the reimbursement (actual amount if known, estimated amount otherwise) and the portion(s) of the project for which the reimbursement will be made.

Oncor proposes to finance its portion of the Proposed Transmission Line Project with a combination of debt and equity in compliance with its authorized capital structure, which is similar to the means used for previous construction projects. Oncor plans to utilize internally generated funds (equity) and proceeds received from the issuance of securities. Oncor will typically obtain short-term borrowings as needed for interim financing of its construction expenditures in excess of funds generated internally. These borrowings are then repaid through the issuance of long-term debt securities, the type and amount of which are currently undetermined.

AEP Texas will finance its portion of the Proposed Transmission Line Project through a combination of debt and equity.

13. Estimated Costs: Provide cost estimates for each route of the proposed project using the following table. Provide a breakdown of "Other" costs by major cost category and amount. Provide the information for each route in an attachment to this application.

	Transmission Facilities	Substation Facilities
Right-of-way and Land Acquisition	*	**
Engineering and Design (Utility)	*	**
Engineering and Design (Contract)	*	**
Procurement of Material and Equipment (including stores)	*	**
Construction of Facilities (Utility)	*	**
Construction of Facilities (Contract)	*	**
Other (all costs not included in the above categories)	*	**
Estimated Total Cost	*	**

* Refer to Attachment No. 3 for cost estimates for each alternative route presented in the Application.

** Refer to Attachment No. 3 for cost estimates for 345 kV additions at Oncor's Sand Lake Switch and at AEP Texas' Solstice Switch to accommodate the Proposed Transmission Line Project. The estimate shown for additions at AEP Texas' Solstice Switch are for upgrades to interconnect the transmission line from Sand Lake in this case, and do not include substation costs associated with the AEP Texas/LCRA TSC line from

Bakersfield Station to Solstice Switch that are separately addressed in Docket No. 48787.

For joint applications, provide and separately identify the above-required information for the portion(s) of the project owned by each applicant.

The Proposed Transmission Line Project is proposed to be split evenly and the estimated costs are likewise projected to be split evenly.

14. Need for the Proposed Project:

For a standard application, describe the need for the construction and state how the proposed project will address the need. Describe the existing transmission system and conditions addressed by this application. For projects that are planned to accommodate load growth, provide historical load data and load projections for at least five years. For projects to accommodate load growth or to address reliability issues, provide a description of the steady state load flow analysis that justifies the project. For interconnection projects, provide any documentation from a transmission service customer, generator, transmission service provider, or other entity to establish that the proposed facilities are needed. For projects related to a Competitive Renewable Energy Zone, the foregoing requirements are not necessary; the applicant need only provide a specific reference to the pertinent portion(s) of an appropriate commission order specifying that the facilities are needed. For all projects, provide any documentation of the review and recommendation of a PURA §39.151 organization.

The Proposed Transmission Line Project and associated station work was reviewed by stakeholders and endorsed by the Electric Reliability Council of Texas ("ERCOT") through the ERCOT Regional Planning Group ("RPG") project review process, as part of the Far West Texas 2 project. ERCOT performed power flow studies as part of the ERCOT RPG process and found voltage violations under the North American Electric Reliability Corporation ("NERC") Standard TPL-001-4 reliability criteria. ERCOT recommended the Proposed Transmission Line Project as one of the components that would provide the most effective solution to meet reliability needs and provide infrastructure to accommodate future load growth. The Proposed Transmission Line Project has also received approval by both the ERCOT Technical Advisory Committee ("TAC") and the ERCOT Board of Directors. See ERCOT Endorsement Letter dated June 2018 and Independent Review dated May 2018 included as Attachment No. 4.

The electric utilities principally serving load in West Texas – Oncor, AEP Texas, and Texas New Mexico – continue to experience load growth in their respective service areas due to oil and natural gas production, mid-stream processing, and associated economic expansion in the area referred to as the Delaware Basin. In order to meet this need, a new transmission line in Pecos, Reeves, and Ward Counties is being proposed to connect Oncor's Sand Lake Switch, located in Ward County, to AEP Texas' Solstice Switch, located in Pecos County. See Attachment No. 5 for the locations of these stations. In addition to the Sand Lake to Solstice Project included in this application, LCRA TSC and AEP Texas are proposing to construct the Bakersfield to Solstice 345 kV electric transmission line to meet the needs of the region.

Pecos, Reeves, and Ward Counties lie within the West Texas region of the Delaware Basin where deep underground shale deposits referred to as "plays" are providing opportunities for oil and natural gas exploration and production. Improvements in oil and natural gas exploration technologies have increased activity in the area and resulted in electric load growth at substations within the Delaware Basin. This growth has resulted in increased load served on Oncor's existing Wink – Culberson Switch 138 kV Line and Yucca Drive Switch – Culberson Switch 138 kV Lines (referred to as "The Culberson Loop"). See Attachment No. 5 for the locations of these lines.

This rapid load growth threatens transmission reliability in the area. Oncor identified numerous contingencies that resulted in unacceptable voltage conditions along The Culberson Loop transmission lines. Studies showed that multiple NERC TPL-001-4 contingences would result in unsolved contingencies during load flow analysis. The unsolved contingencies show an inability of the power system to maintain acceptable voltages following a disturbance, resulting in potential voltage collapse along these lines. Such scenarios could cause all customers served from these lines to be dropped.

Ultimately Oncor determined that a strong source, which a new 345 kV injection provides, is required to support voltage conditions in the area, especially as load continues to grow. As a result, Oncor and AEP Texas proposed the Far West Texas Project to the ERCOT RPG, which included a new 345 kV transmission loop between Odessa EHV to Moss to Riverton to Sand Lake to Solstice to Bakersfield stations. See Attachment 6 for the Oncor and AEP Texas Far West Texas Project RPG Submittal report.

As part of the original Far West Texas Project, ERCOT saw similar concerns and confirmed the need for 345 kV facilities in the project study area. ERCOT recommended the establishment of a new 345 kV transmission line between the Riverton and Odessa EHV Switch stations, and a new 345 kV transmission line between the Solstice and Bakersfield stations. For details of ERCOT's analysis and recommendations in the original Far West Texas Project, please see ERCOT's June 2017 Endorsement Letter and Independent Review dated May 2017 included as Attachment No. 7.

ERCOT also indicated the potential need for future improvements as load grows in the area, including future 345 kV circuits between Riverton and Sand Lake, as well as Sand Lake and Solstice (the Proposed Transmission Line Project). This 345 kV line segment from Riverton to Sand Lake to Solstice was part of the original Far West Texas Project proposal; however, ERCOT did not initially approve construction of all these segments as part of its independent review. ERCOT recommended that the need for these circuits be re-evaluated when confirmed load projections on The Culberson Loop reached 717 MW.

Table 1 below shows the sum of historical and projected summer peak loads (MW) for the substations on The Culberson Loop transmission lines. The loads from 2013 to 2017 are actual non-coincident summer peaks. The load for 2018 is the projected peak, expected to occur between last date the forecast was updated and the end of the year, and only includes confirmed load increases for Oncor substations and customer requests that have signed agreements for service. The loads for 2019 to 2023 are projected non-coincident summer peaks and only include confirmed load increases for Oncor substations and customer requests that have signed agreements for service.

	Historical Load					Projected Load					
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total (MW)	53.2	89.7	105.4	231	304	771	902	1318	1475	1549	1597

Table 1 - Historical and Projected Load on the Wink – Culberson and Yucca Drive – Culberson 138 kV Transmission Lines

With future load additions, Oncor's steady state contingency analysis shows that loss of the future radial Odessa EHV – Riverton 345 kV Line, a NERC category P1.2 contingency, results in multiple voltage violations along The Culberson Loop as load grows along these lines in future years. The result indicates that a single-line outage of the radial 345 kV transmission line will result in a service interruption to all customers served within The Culberson Loop. This analysis also indicates that taking a clearance on the radial 345 kV line will be problematic.

As a result, Oncor, in coordination with AEP Texas and LCRA TSC, proposed the Far West Texas Project 2 to the ERCOT RPG, which included the Riverton to Sand Lake and Sand Lake to Solstice 345-kV Lines and the initial installation of the second circuit on the Bakersfield to Solstice 345-kV Line. These projects would provide bidirectional service for the 345-kV source into The Culberson Loop, ultimately addressing the criteria violations mentioned previously. See Attachment 8 for the Oncor Far West Texas Project 2 RPG Submittal report. ERCOT's independent review confirmed the reliability need to expand the 345 kV transmission system in the region. Constructing the Bakersfield to Solstice and Sand Lake to Solstice 345-kV lines will be components to allow bidirectional flow in the area on the new 345-kV lines, ultimately allowing voltage support from the stronger 345-kV injection to address reliability concerns in the region such as the single-line outage of a radial 345-kV line. In addition, this would improve: operational flexibility during emergency conditions, obtaining clearances for maintenance of equipment, and connecting new loads to the system.

On June 12, 2018, the ERCOT Board of Directors endorsed the recommendation of the Independent Review recommending transmission improvements, including the components of the Project that are the subject of this application. See ERCOT Endorsement Letter dated June 2018 and Independent Review dated May 2018 included as Attachment No. 4.

Critical Designation

In May 2018, Oncor, AEP Service Company(AEPSC) on behalf of AEP Texas, and LCRA TSC submitted a formal request to ERCOT to grant critical designation status for the Riverton – Sand Lake, Sand Lake – Solstice, and Bakersfield – Solstice 345 kV Lines, pursuant to 16 Texas Administrative Code § 25.101 (b)(3)(D). See letter dated May 14, 2018 included as Attachment 9.

In the request, the companies described the acceleration of load growth being experienced in the region and the criticality of 345 kV service to the reliability of the area. Load growth in the area has surpassed ERCOT's expected load serving capability for existing planned projects in the area.

On June 12, 2018, the ERCOT Board of Directors designated the Riverton - Sand Lake 345 kV line, the Sand Lake - Solstice 345 kV line, and the Bakersfield - Solstice 345 kV line as critical to the reliability of the ERCOT System. See ERCOT Board of Directors' resolution included as Attachment 10.

ERCOT's endorsement and critical designation confirms the multiple operational and reliability needs for the Proposed Transmission Line Project, and highlights the necessity for the 345 kV facilities to be placed in-service as soon as possible.

Supplemental Information

On October 15, 2018, ERCOT identified the completion of the 345-kV components of the Far West Texas Project and the Far West Texas Project 2 that complete a transmission path from Bakersfield to Solstice to Sand Lake to Riverton to Odessa as the exit strategy for a Generic Transmission Constraint established for the McCamey area.

15. Alternatives to Project:

For a standard application, describe alternatives to the construction of this project (not routing options). Include an analysis of distribution alternatives, upgrading voltage or bundling of conductors of existing facilities, adding transformers, and for utilities that have not unbundled, distributed generation as alternatives to the project. Explain how the project overcomes the insufficiencies of the other options that were considered.

Alternatives to the Proposed Transmission Line Project were studied as part of the ERCOT RPG process in both the Far West Texas Project and the Far West Texas Project 2.

Far West Texas Project

In ERCOT's independent review of the Far West Texas Project, ERCOT reviewed 40 different alternatives. The alternatives included numerous variations of different 138 kV and 345 kV transmission lines and reactive compensation devices. Additionally, ERCOT examined various termination points for new transmission lines and new reactive compensation. Ultimately ERCOT narrowed down the alternatives to four main options for detailed study.

Option 1:

- Install a new 200 MVAR Dynamic Synchronous Condenser at Mentone 138 kV Substation.
- Install a new 200 MVAR Dynamic Synchronous Condenser at Culberson 138 kV Substation.

- Construct a new approximately 85-mile 345 kV line operating at 138 kV on double-circuit structures with one circuit in place, between Moss and Riverton Switch stations.
- Add a second circuit to the existing 16-mile Moss Switch station – Odessa EHV 345 kV double-circuit structures. Connect the new circuit from Riverton Switch station and terminate at Odessa EHV to create the new Odessa EHV - Riverton 345 kV line operating at 138 kV.
- Build a new McCamey – Fort Stockton 345 kV double circuit line operating at 138 kV (requiring approximately 47-miles of new right of way).
- Build a new Pig Creek – Fort Stockton 345 kV single circuit line operating at 138 kV (requiring approximately 39-miles of new right of way).
- Install a new 50 MVAR capacitor bank each at Mentone and Salt Creek 138 kV Substations.
- Install a new 18 MVAR capacitor bank each at Orla, Elmar, Loving and Alamito Creek 138 kV Substations.
- Install a new 3.6 MVAR capacitor bank at Espy Wells 69 kV Substation.
- Install a new 10.8 MVAR capacitor bank at Shafter Goldmine 69 kV Substation.
- Install a new 7.2 MVAR capacitor bank at Sanderson TNP 69 kV Substation.

The total cost estimate for Option 1 is approximately $464 million.

Option 2:

- Expand the Riverton Switch station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers.
- Construct a new approximately 85-mile 345 kV line on double-circuit structures with one circuit in place, between Moss and Riverton Switch stations. Add a second circuit to the existing 16-mile Moss Switch – Odessa EHV 345 kV double-circuit structures. Install 345 kV circuit breaker(s) at Odessa EHV. Connect the new circuit from Riverton Switch station and terminate at Odessa EHV to create the new Odessa EHV – Riverton 345 kV Line.
- Expand the Solstice Switch station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers.
- Construct a new approximately 68-mile 345 kV line from Solstice Switch station to Bakersfield station on double-circuit structures with one circuit in place.

The total cost estimate for Option 2 is approximately $336 million.

Option 3:

- Expand the Riverton Switch station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers.
- Construct a new approximately 85-mile 345 kV line on double-circuit structures with one circuit in place, between Moss and Riverton Switch stations. Add a second circuit to the existing 16-mile Moss Switch – Odessa EHV 345 kV double-circuit structures. Install 345 kV circuit breaker(s) at Odessa EHV.

Connect the new circuit from Riverton Switch station and terminate at Odessa EHV to create the new Odessa EHV – Riverton 345 kV Line.

- Expand the Riverton Switch station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers.
- Expand the Sand Lake Switch station to install a 345 kV ring-bus arrangement with one 600 MVA, 345/138 kV autotransformer.
- Expand the Solstice Switch station to install a 345 kV ring-bus arrangement with two 600 MVA, 345/138 kV autotransformers.
- Construct a new approximately 41-mile 345 kV line on double-circuit structures with one circuit in place, Sand Lake – Solstice 345 kV single circuit line (the proposed transmission line).
- Add a second circuit to the Riverton – Mentone – Sand Lake 345 kV to create a Riverton – Sand Lake 345 kV line on the existing Riverton – Mentone – Sand Lake 345 kV line operating at 138 kV.
- Construct a new approximately 68-mile 345 kV line from Solstice Switch to Bakersfield on double-circuit structures with one circuit in place.

The total cost estimate for Option 3 is approximately $446 million.

Option 4:

- Option 4 is same as Option 3 with an additional new 200 MVAR Synchronous Condenser at Culberson 138 kV Substation.

The total cost estimate for Option 4 is approximately $501 million.

ERCOT's analysis indicated that all of the four options addressed the reliability needs in The Culberson Loop with the projected load conditions at the time of the submittal in 2016. Oncor provided additional information to ERCOT for additional loads not yet under contract as of the study date, but which were known to want service in the near future. ERCOT used this information for their sensitivity study in which they found that all NERC criteria violations could not be addressed by Options 1 and 2. Options 3 and 4 showed no violations even under the sensitivity study scenario.

ERCOT endorsed Option 2 as the best solution to address the reliability needs of the region. Option 3 and 4, which included the Proposed Transmission Line Project, were recommended as a future upgrade path if load continued to grow in the area. Ultimately elements of Option 3 and 4, including the proposed transmission line, were later endorsed by ERCOT through its independent review of the Far West Texas Project 2.

<u>Far West Texas Project 2</u>

In ERCOT's independent review of the Far West Texas Project 2, ERCOT revisited the alternatives and approved project elements from the initial Far West Texas Project based on new load additions in the region. ERCOT narrowed down a shortlist of "universal" transmission upgrades as part of its alternatives development in order to align with the expansion options from its original analysis of the Far West Texas Project.

The Proposed Transmission Line Project was included as part of that "universal" options list since it is a necessary component to close the 345 kV loop in the area, a key element in ERCOT's analysis and recommended solution.

The "universal" options included:

- Construct a new approximately 40-mile 345 kV line on double-circuit structures with two circuits in place from Sand Lake 345 kV Switch to Solstice 345 kV Switch (the Proposed Transmission Line Project).
- Add two new 600 MVA, 345/138 kV autotransformers at Sand Lake 345 kV Switch station.
- Install a new 345 kV circuit on the planned Riverton – Sand Lake double circuit structures.
- Install the second 345 kV circuit on the Odessa EHV – Riverton 345 kV line double circuit structures between Moss and Riverton (creating a Moss – Riverton 345 kV circuit).
- Construct a new Quarry Field 138 kV Switch station in the Wink – Riverton double-circuit 138 kV line.
- Construct a new approximately 20-mile Kyle Ranch – Riverton 138 kV line on double-circuit structures with one circuit in place from Kyle Ranch 138 kV Substation to Riverton 138 kV Switch station.
- Construct a new approximately 20-mile Owl Hills – Tunstill – Riverton 138 kV line on double circuit structures with one circuit in place from Owl Hills 138 kV Substation to Riverton 138 kV Switch station.
- Install the second 345 kV circuit on the planned Solstice Switch – Bakersfield Switch double circuit structures.

Using these "universal" upgrades in each of the final options, ERCOT further studied three final options.

Option 1:

- Install two 250 MVAR Static Synchronous Compensators at Horseshoe Springs 138 kV Switch station.

The total cost estimate for Option 1 is approximately $300.0 million.

Option 2:

- Install one 250 MVAR Static Synchronous Compensator ("STATCOM") at Horseshoe Springs 138 kV Switch station.
- Install capacitor banks with a total capacity of 150 MVAR at Horseshoe Springs 138 kV Switch station.
- Install capacitor banks with a total capacity of 150 MVAR at Quarry Field 138 kV Switch station.

The total cost estimate for Option 2 is approximately $292.5 million.

Option 3:

- Install one 250 MVAR STATCOM at Horseshoe Springs 138 kV Switch station.

- Install one 250 MVAR STATCOM at Quarry Field 138 kV Switch station.
- Install capacitor banks with a total capacity of 150 MVAR at Horseshoe Springs 138 kV Switch station.
- Install capacitor banks with a total capacity of 150 MVAR at Quarry Field 138 kV Switch station.

The total cost estimate for Option 3 is approximately $446.0 million.

ERCOT's analysis indicated that all three options addressed the reliability needs in The Culberson Loop with the projected future load conditions. ERCOT ultimately recommended Option 3 as the option with the best load serving capability to accommodate both near-term and potential future load needs in the area.

All three options included the Proposed Transmission Line Project since an independent 345 kV source into The Culberson Loop is a key element for addressing the area concerns. The Sand Lake Switch station was chosen as an end point for the Proposed Transmission Line Project because of its ideal location for electrical connection, since it bisects the Yucca Drive – Culberson 138 kV Line and is in an immediate geographical pocket where load is growing. Many of the new high voltage interconnections for new loads in this area are in the vicinity of the Sand Lake Switch location and thus would benefit from the new 345 kV source.

Sand Lake also provides a network hub for the future 345 kV injection because of the other projects being connected there, namely the Riverton – Sand Lake 138 kV Line, which is planned to be in-service in 2019. Sand Lake is the end point for the in-progress Riverton – Sand Lake 138 kV Line, which is planned to be constructed to 345 kV standards in anticipation for the future Riverton – Sand Lake 345 kV Line. The Riverton – Sand Lake 345 kV Line is the other component to closing the 345 kV loop in the region, and a different endpoint from Sand Lake would not take advantage of the already in-progress project.

Additionally, Sand Lake is also geographically adjacent to Texas New Mexico Power's transmission system in the area. It is anticipated that as load on both companies' transmission system grows, a new interconnection between the two companies will be needed, and Sand Lake provides an ideal location for doing so, without requiring a new CCN transmission line.

Similarly, Solstice Switch was chosen as an end point for the Proposed Transmission Line Project because of its ideal location for electrical connection. At the Solstice and the adjacent Barilla Junction stations, there are terminations of eight different transmission circuits with connections to major switch stations for the region, including Pig Creek/Yucca Drive, Fort Stockton Switch, and Fort Stockton Plant. All lines and customers served from these lines would benefit from the new 345 kV source. Since Solstice Switch is a major 138 kV transmission hub within Pecos County, all of these transmission lines and customers served from these lines would benefit from the future 345 kV injection. Solstice Switch is also the end point for the planned Bakersfield –

Solstice 345 kV Line. A different endpoint from Solstice Switch would not take advantage of the already planned project to bring 345 kV facilities to the area.

Distribution alternatives are not practical alternatives since they would not improve the reliability and operational capability of the transmission system in the area.

Upgrading voltage of existing facilities would not be practical since a new independent 345 kV source and pathway in the area is needed, and all existing facilities in the area are either constructed and operated at 138 kV or being upgraded for the capability. The 138 kV facilities in the area currently serve customers directly, so upgrading voltage on those lines would require all customers and existing stations to be rebuilt in order to be served from 345 kV.

Increasing the capacity of the radial 345-kV facilities already certificated and under construction by Oncor or bundling of conductors on existing 138-kV facilities would not address the reliability and operational issues under the contingency of concern because bundling conductors does not provide bi-directional looped service capability which is needed to address the reliability issues and provide operational flexibility for existing and future customers. Adding transformers would not address the reliability and operational issues under the contingency of concern since new 345/138 kV transformers within The Culberson Loop would still be served from the Proposed Transmission Line Project. The only existing planned 345 kV source is at Riverton, and any additional transformer at that station would still be placed out of service under the same contingency of concern without the Proposed Transmission Line Project.

These reliability and operational issues are discussed in further detail in Brent Kawakami's direct testimony.

16. Schematic or Diagram:

For a standard application, provide a schematic or diagram of the applicant's transmission system in the proximate area of the project. Show the location and voltage of existing transmission lines and substations, and the location of the construction. Locate any taps, ties, meter points, or other facilities involving other utilities on the system schematic.

A schematic of the transmission system, with the location and voltage of existing transmission lines in the proximate area of the Proposed Transmission Line Project, is included as Attachment No. 11.

17. Routing Study:

Provide a brief summary of the routing study that includes a description of the process of selecting the study area, identifying routing constraints, selecting potential line segments, and the selection of the routes. Provide a copy of the complete routing study conducted by the utility or consultant. State which route the applicant believes best addresses the requirements of PURA and P.U.C. Substantive Rules.

Oncor and AEP Texas retained Halff to prepare the Environmental Assessment and Routing Study. The objective of the Environmental Assessment and Routing Study was to provide information in support of this Application in addressing the requirements of

Section 37.056(c)(4)(A)-(D) of the Texas Utilities Code, the PUCT CCN Application form, and 16 Tex. Admin. Code § 25.101 as these apply to the Proposed Transmission Line Project. By examining existing environmental conditions, including the human and natural resources that are located in the project area, the Environmental Assessment and Routing Study appraises the environmental effects that could result from the construction, operation, and maintenance of the Proposed Transmission Line Project, *i.e.*, construction of a 345 kV transmission line between the Oncor Sand Lake Switch in Ward County and the AEP Texas Solstice Switch in Pecos County. The Environmental Assessment and Routing Study may also be used in support of any additional local, state, or federal permitting activities that may be required for the Proposed Transmission Line Project.

To assist Halff in its evaluation, Oncor and AEP Texas provided information regarding the project endpoints, the need for the project, engineering and design requirements, construction practices, and ROW requirements for the Proposed Transmission Line Project.

After considering environmental and geographical data, Halff defined a study area that encompassed the provided endpoints with a sufficient area to identify routing. *See* Section 3.0 of the Environmental Assessment and Routing Study, included as Attachment No. 1, for a discussion of the study area. Routing constraints were identified after collection of area data from many sources (*e.g.*, governmental agencies, evaluation of aerial photography), consideration of criteria established in Section 37.056(c)(4)(A)-(D) of the Texas Utilities Code, the PUCT's CCN Application form, and 16 Tex. Admin. Code § 25.101.

Potential links were identified by evaluating the constraints mapped for the study area and then developing potential opportunity areas such as existing corridors and other linear features. Corridors were identified and developed into potentially viable routes. Impacts were evaluated by Halff for each identified preliminary alternative route.

Oncor and AEP Texas then evaluated the routes, and selected Route 320 as the route that best addresses the requirements of the Texas Utilities Code and the PUCT's Substantive Rules.

Specific discussions regarding the study area, identification of constraints, selection of potential line segments, and alternative route analysis are set forth in the Environmental Assessment and Routing Study. Specific discussion regarding the evaluation and selection of routes filed with the Application and the route that Oncor and AEP Texas believe best complies with the requirements of the Texas Utilities Code and the PUCT Substantive Rules is contained in an office memorandum from Ms. Brenda J. Perkins (included as Attachment No. 12).

18. Public Meeting or Public Open House:

Provide the date and location for each public meeting or public open house that was held in accordance with 16 TAC §22.52. Provide a summary of each public meeting or public open house including the approximate number of attendants, and a copy of any survey provided to attendants and a summary of the responses received. For each public meeting or public

open house provide a description of the method of notice, a copy of any notices, and the number of notices that were mailed and/or published.

One public participation meeting was hosted by Oncor and AEP Texas. It was attended by Oncor, AEP Texas, and Halff personnel, as well as personnel from TRC Solutions, Inc., a contractor assisting the Joint Applicants in property abstracting. The public participation meeting was held August 15, 2018, from 4:00 p.m. to 7:00 p.m. at the Reeves County Civic Center in Pecos, Texas.

Oncor, on behalf of Joint Applicants, mailed a total of approximately 775 individual written notices of the meeting to all owners of property within 500 feet of the centerline of the preliminary alternative route links for the Proposed Transmission Line Project. Also, a public notice was placed in the local newspapers listed below announcing the location, time, and purpose of the meeting. Oncor, on behalf of Joint Applicants, also provided notice of the public meeting to the Department of Defense Siting Clearinghouse.

Published Notices

Newspaper	County	Publication Date
Fort Stockton Pioneer	Pecos	August 9, 2018
Monahans News	Ward	August 9, 2018
Pecos Enterprise	Reeves	August 9, 2018

The meeting was designed to solicit comments and input from residents, landowners, public officials, and other interested parties concerning the Proposed Transmission Line Project. The objectives included promoting an understanding of the Proposed Transmission Line Project including the purpose, need, and potential benefits and impacts; informing and educating the public with regard to the routing process and schedule; and gathering information about the values and concerns of the public and community leaders.

The meeting was configured in an informal information station format rather than a formal speaker/audience format with each station assigned to a particular aspect of the project, or routing process, and staffed with representatives from Oncor, AEP Texas and/or Halff. Each station had exhibits, maps, illustrations, aerial photography, or other information describing certain project aspects and subject matter information. Attendees were encouraged at the meeting initiation to visit each station in order, so the entire process could be explained in the general sequence of project development. Oncor and AEP Texas have found this meeting format valuable due to its informality and because it allows attendees the opportunity to gather information most important to them and to spend as much time as necessary with those particular project aspects. Additionally, individual discussions allow for and encourage more interaction from attendees who otherwise might be hesitant to participate in a more formal setting.

Nine individuals signed in as attendees at the public participation meeting, including one member of the local media and one local official. Of those attendees, one submitted a questionnaire at the meeting, and electronic data was received from the local official attendee after the meeting. No questionnaires or letters were received via mail at a later date by Oncor, AEP Texas, or Halff.

Additional discussion concerning the public involvement program and specific information regarding the public participation meeting may be found in the Environmental Assessment and Routing Study, Section 2.5, pages 2-10 through 2-11, and Section 5.0, pages 5-1 through 5-2, included as Attachment No. 1. A representative copy of the notice that was provided to property owners and a copy of the questionnaire provided to meeting attendees is included in Appendix B of Attachment No. 1.

19. Routing Maps:

Base maps should be a full scale (one inch = not more than one mile) highway map of the county or counties involved, or other maps of comparable scale denoting sufficient cultural and natural features to permit location of all routes in the field. Provide a map (or maps) showing the study area, routing constraints, and all routes or line segments that were considered prior to the selection of the routes. Identify the routes and any existing facilities to be interconnected or coordinated with the project. Identify any taps, ties, meter points, or other facilities involving other utilities on the routing map. Show all existing transmission facilities located in the study area. Include the locations of radio transmitters and other electronic installations, airstrips, irrigated pasture or cropland, parks and recreational areas, historical and archeological sites (subject to the instructions in Question 27), and any environmentally sensitive areas (subject to the instructions in Question 29).

Two one inch = 3,000 feet maps (Environmental Assessment and Routing Study Figures 3-1A and 3-1B) are included in Attachment No. 1. These base maps include sufficient cultural and natural features to permit the location of all routes in the field. These base maps also delineate the study area, routing constraints, and route links considered in the selection of routes. These base maps also depict the approximate locations of radio transmitters and other electronic installations, airstrips, irrigated pasture or cropland, parks and recreational areas, historical and archeological sites, and any environmentally sensitive areas. Finally, these base maps depict existing facilities in the area of the Proposed Transmission Line Project, including taps, ties, meter points, or other utility facilities, as applicable.

Provide aerial photographs of the study area displaying the date that the photographs were taken or maps that show (1) the location of each route with each route segment identified, (2) the locations of all major public roads including, as a minimum, all federal and state roadways, (3) the locations of all known habitable structures or groups of habitable structures (see Question 19 below) on properties directly affected by any route, and (4) the boundaries (approximate or estimated according to best available information if required) of all properties directly affected by any route.

Figures 3-1A and 3-1B depict on an aerial photograph: (1) the location of each link that is used in the alternative routes filed in this CCN with each link identified, (2) the locations of all major public roads including all federal and state roadways, (3) the locations of all known habitable structures on properties directly affected by any link used in the alternative routes, and (4) the boundaries (approximate or estimated according to available county tax information) of all properties directly affected by any link used in an alternative route. In addition, the locations of radio transmitters and other electronic installations, airstrips, irrigated pasture or cropland, parks and recreational areas, historical and archeological sites, and any environmentally sensitive areas are depicted, if any.

For each route, cross-reference each habitable structure (or group of habitable structures) and directly affected property identified on the maps or photographs with a list of corresponding landowner names and addresses and indicate which route segment affects each structure/group or property.

Attachment No. 14 is a table that cross references each habitable structure and directly affected property identified in Figures 3-1A and 3-1B of Attachment No. 1; the cross reference table includes corresponding landowner names and addresses and indicates which link and alternative route affects each structure or property.

20. Permits:

List any and all permits and/or approvals required by other governmental agencies for the construction of the proposed project. Indicate whether each permit has been obtained.

The following permits/approvals will be obtained by Oncor and AEP Texas after PUC approval of the CCN and prior to beginning construction, if necessary:

1. Texas Department of Transportation permit(s) for crossing a state-maintained roadway.
2. A Storm Water Pollution Prevention Plan will be prepared and a Notice of Intent will be submitted to the Texas Commission on Environmental Quality under the Texas Pollutant Discharge Elimination System program.
3. A cultural resources survey plan will be developed with the Texas Historical Commission ("THC") for the Proposed Transmission Line Project.
4. Consultation with the U.S. Army Corps of Engineers will occur following the Commission's approval of this Application to determine appropriate requirements under Section 404/Section 10 Permit criteria.
5. Consultation with the U.S. Fish and Wildlife Service will occur following the Commission's approval of this Application to determine appropriate requirements under the Endangered Species Act.

21. Habitable structures:

For each route list all single-family and multi-family dwellings and related structures, mobile homes, apartment buildings, commercial structures, industrial structures, business structures, churches, hospitals, nursing homes, schools, or other structures normally inhabited by humans or intended to be inhabited by humans on a daily or regular basis within 300 feet of the centerline *if the proposed project will be constructed for operation at* 230 kV or less, or within 500 feet of the centerline if the proposed project will be constructed for operation at greater than 230 kV. Provide a general description of each habitable structure and its distance from the centerline of the route. In cities, towns or rural subdivisions, houses can be identified in groups. Provide the number of habitable structures in each group and list the distance from the centerline of the route to the closest and the farthest habitable structure in the group. Locate all listed habitable structures or groups of structures on the routing map.

A listing of all habitable structures located within 500 feet of each proposed link centerline use in the alternative routes filed in this CCN, along with a general description of each habitable structure and its distance from the centerline of the link and the alternative routes associated is provided in the table below.

Habitable Structure	Distance (ft.)	Description	Direction*	Link	Route
1	226	SFR*	North/Northeast	B2	280, 281, 282, 292, 293, 296, 297, 310, 320, 324, 325, 326, 328, 329, 357, 366, 370, 404
2	264	MLU[1]	North/Northeast	B2	
3	264	MLU	North/Northeast	B2	
4	264	MLU	Northwest	B2	
5	264	MLU	Southeast	B2	
6	264	MLU	Northwest	B2	
7	264	MLU	Northwest	B2	
8	264	MLU	Northwest	B2	
9	484	MLU	South/Southeast	B2	
10	484	MLU	South/Southeast	B2	
11	481	MLU	Northeast	B2	
12	481	MLU	Northwest	B2	
13	440	MLU	Northwest	B2	
14	439	MLU	Northwest	B2	
15	439	MLU	Northwest	B2	
16	439	MLU	Northwest	B2	
17	439	MLU	Northwest	B2	
18	439	MLU	Northwest	B2	
19	439	MLU	Northwest	B2	
20	439	MLU	Northwest	B2	
21	206	SFR	Northwest	B2	
22	266	MLU	West	B2	
23	266	MLU	South	B2	
24	266	MLU	South/Southwest	B2	
25	266	MLU	East/Northeast	B2	
26	266	MLU	North/Northeast	B2	
27	266	MLU	North/Northeast	B2	
28	266	MLU	North/Northeast	B2	
29	266	MLU	North/Northeast	B2	
30	266	MLU	North/Northeast	B2	
31	266	MLU	North/Northeast	B2	
32	266	MLU	North/Northeast	B2	
33	266	MLU	North/Northeast	B2	
34	383	MLU	North/Northeast	B2	
35	339	SFR	North/Northeast	B2	
36	398	Industrial	North/Northeast	C1	
37	424	SFR	North/Northeast	C1	
38	379	MLU	North/Northeast	C1	

Habitable Structure	Distance (ft.)	Description	Direction*	Link	Route
39	309	MLU	North/Northeast	C1	
40	313	MLU	North/Northeast	C1	
41	311	MLU	North/Northeast	C1	
42	350	MLU	North/Northeast	C1	
43	351	MLU	North/Northeast	C1	
44	348	MLU	North/Northeast	C1	
45	352	MLU	North/Northeast	C1	
46	347	MLU	North/Northeast	C1	
47	374	MLU	North/Northeast	C1	
48	361	MLU	North/Northeast	C1	
49	381	MLU	North/Northeast	C1	
50	503	SFR	North/Northeast	C1	370, 404
51	376	MOU[2]	Southeast	C1	
52	376	MOU	Southeast	C1	
53	376	MOU	Southeast	C1	
54	376	MOU	Southeast	C1	
55	376	MOU	Southeast	C1	
56	376	MOU	Southeast	C1	
57	376	MOU	Southeast	C1	
58	376	MOU	Southeast	C1	
59	376	MOU	Southeast	C1	
60	376	MOU	Southeast	C1	
61	376	MOU	Southeast	C1	
62	491	Industrial	Southeast	C1	
63	451	Industrial	Southeast	C1	
64	280	Industrial	Southeast	C1	
65	248	SFR	Northeast	D2	3, 13, 14, 18, 41, 280, 281, 282, 292, 293, 296, 297, 310, 320, 324
66	490	Industrial	West	H1	13, 14, 131, 292, 293, 296
67	491	MOU	Southeast	Z	All Filed Routes
68	405	MOU	Southeast	Z	

Notes:
* - Direction represents the distance beginning from the habitable structure towards the provided link.
‡ - Single family residence associated with a permanent foundation.

[1] - Denotes mobile living units. These units have no permanent foundation and are in the travel trailer style.
[2] - Denotes mobile office unit, associated primarily with oil and gas facilities construction sites. These are prefabricated mobile units brought to these sites temporarily until completion of the project.

Figures 3-1A and 3-1B (map pockets) located in Application Attachment No. 1, depict on aerial photography the locations of all known habitable structures directly affected by the links used in the proposed alternative routes.

22. Electronic Installations:

For each route, list all commercial AM radio transmitters located within 10,000 feet of the center line of the route, and all FM radio transmitters, microwave relay stations, or other similar electronic installations located within 2,000 of the center line of the route. Provide a general description of each installation and its distance from the center line of the route. Locate all listed installations on a routing map.

There is one known AM radio transmitter that is located within 10,000 feet of the centerline of any alternative route. There are no known FM radio transmitters that are located within 2,000 feet of the centerline of any alternative route.

There are five known communication towers (microwave relay stations or other similar electronic installations) that are within 2,000 feet of one or more alternative routes.

The approximate distances from each of the alternative route links and corresponding routes to the AM radio transmitter and the communication towers are summarized in the table below.

Facility ID	Installation Type	Routes	Link	Distance to Link (feet)	Direction
AM RADIO TRANSMITTERS WITHIN 10,000 FEET OF A ROUTE					
KIUN	AM	370, 404	C1	6,890	Northwest
*****THERE ARE NO FM RADIO TRANSMITTERS WITHIN 2,000 FEET OF A ROUTE*****					
OTHER ELECTRONIC INSTALLATIONS WITHIN 2,000 FEET OF ROUTE					
Tower 1	Microwave	46, 49, 78, 325, 326, 328, 329, 357, 366	D1	1,240	Northwest
Tower 2	Unknown	3, 13, 14, 280, 281, 282, 292, 293, 296	E2	1,190	Northeast
Tower 3	Unknown	13, 14, 131, 292, 293, 296	H1	420	Northwest
Tower 4	Unknown	296, 324, 366	J21	650	Northeast
Tower 5	Microwave		J21	940	West

See Section 3.7.7, page 3-75 and Section 7.7.6, page 7-20 of the Environmental Assessment and Routing Study, included as Attachment No. 1.

Radio transmitters and communications towers located within the project area are shown in Figures 3-1A and 3-1B (map pockets) of the Environmental Assessment and Routing Study, included as Attachment No. 1.

23. Airstrips:

For each route, list all known private airstrips within 10,000 feet of the center line of the project. List all airports registered with the Federal Aviation Administration (FAA) with at least one runway more than 3,200 feet in length that are located within 20,000 feet of the center line of any route. For each such airport, indicate whether any transmission structures will exceed a 100:1 horizontal slope (one foot in height for each 100 feet in

distance) from the closest point of the closest runway. List all listed airports registered with the FAA having no runway more than 3,200 feet in length that are located within 10,000 feet of the center line of any route. For each such airport, indicate whether any transmission structures will exceed a 50:1 horizontal slope from the closest point of the closest runway. List all heliports located within 5,000 feet of the center line of any route. For each such heliport, indicate whether any transmission structures will exceed a 25:1 horizontal slope from the closest point of the closest landing and takeoff area of the heliport. Provide a general description of each listed private airstrip, registered airport, and heliport; and state the distance of each from the center line of each route. Locate and identify all listed airstrips, airports, and heliports on a routing map.

Halff's review of federal and state aviation/airport maps and directories, aerial photography, and reconnaissance surveys, identified the following: two FAA-registered airports with a runway greater than 3,200 feet in length within 20,000 feet of a proposed alternative route; no FAA-registered airport with a runway of 3,200 feet or less in length within 10,000 feet of a proposed alternative route; no heliport within 5,000 feet of a proposed alternative route; and no private airstrips within 10,000 feet of a proposed alternative route. These two air facilities and their approximate distances to the alternative route link and corresponding alternative routes are provided in the table below, as well as Table 7-5 of the Environmental Assessment and Routing Study, included as Attachment No. 1.

Facility Name	Facility Use	Landing Facility Description	Routes	Link	Distance to Link (feet)	Direction to Link	May Exceed Horizontal Slope[1]
FAA REGISTERED AIRPORT WITH RUNWAY GREATER THAN 3,200 FEET WITHIN 20,000 FEET OF ROUTE							
Pecos Municipal Airport	Public	Two runways	370, 404	C1	18,360	Northwest	
			46, 49, 78, 325, 326, 328, 329, 357, 366	D1	9,780	Southeast	X
Gnaws Farm	Private	One runway	370, 44	C1	19,720	Northeast	
*****THERE ARE NO FAA REGISTERED AIRPORTS WITH RUNWAY LESS THAN 3,200 FEET WITHIN 10,000 FEET OF A ROUTE*****							
*****THERE ARE NO NON-REGISTERED RUNWAYS WITHIN 10,000 FEET OF A ROUTE*****							
***** THERE ARE NO HELIPORTS WITHIN 5,000 FEET OF A ROUTE *****							

1 – Assuming no elevation variation exists and a typical structure height of 125 feet

2 – If the PUCT approves this project with double-circuit capacity, then routes using this link will be evaluated consistent with FAA guidelines.

Oncor and AEP Texas will evaluate these airstrips relative to the PUCT selected alternative route during the engineering phase of the Proposed Transmission Line Project and will notify and coordinate with the FAA as necessary.

No significant impacts on these airstrips are anticipated from construction of the Proposed Transmission Line Project. *See* Section 3.7.6, pages 3-73 through 3-74 and Section 7.7.5, pages 7-18 through 7-19 of the Environmental Assessment and Routing Study, included as Attachment No. 1.

Figures 3-1A and 3-1B (map pockets) of the Environmental Assessment and Routing Study, included as Attachment No. 1, depict the locations of the listed airstrips located within or in proximity to the project area.

24. Irrigation Systems:

For each route identify any pasture or cropland irrigated by traveling irrigation systems (rolling or pivot type) that will be traversed by the route. Provide a description of the irrigated land and state how it will be affected by each route (number and type of structures etc.). Locate any such irrigated pasture or cropland on a routing map.

Results of aerial photography interpretation and field reconnaissance surveys identified approximately 3,043 feet of pasture or cropland irrigated by traveling irrigation systems (rolling or pivot type) that will be traversed by two of the filed alternative routes. However, as is noted in Table 7-2 in Appendix E of the Environmental Assessment and Routing Study (included as Attachment No. 1), these particular mobile irrigation systems appear to be no longer in use.

25. Notice:

Notice is to be provided in accordance with 16 TAC §22.52.

A. Provide a copy of the written direct notice to owners of directly affected land. Attach a list of the names and addresses of the owners of directly affected land receiving notice.

A copy of the written direct notice, with attached map, that will be provided to owners of directly affected land is included as Attachment No. 13. A list of the names and addresses of those owners of directly affected land to whom notice will be mailed by first-class mail is included as Attachment No. 14.

B. Provide a copy of the written notice to utilities that are located within five miles of the routes.

A copy of the written notice, with attached map, provided to the utilities providing electric service within a five mile radius of the proposed alternative routes for Proposed Transmission Line Project is attached as Attachment No. 15. The following utilities will be provided the requisite notice on or before the filing date:

Texas New Mexico Power Company
Rio Grande Electric Cooperative

C. Provide a copy of the written notice to county and municipal authorities, and the Department of Defense Siting Clearinghouse. Notice to the DoD Siting Clearinghouse should be provided at the email address found at http://www.acq.osd.mil/dodsc/.

osd.dod-siting-clearinghouse@mail.mil

A representative copy of the written notice, with attached map, that will be provided to county and municipal authorities is included as Attachment No. 15. The following county agencies will be provided the requisite notice on or before the filing date:

Pecos County, County Judge
Pecos County, County Commissioners – Precincts 1, 2, 3 and 4
Reeves County, County Judge
Reeves County, County Commissioners – Precincts 1, 2, 3 and 4
Ward County, County Judge
Ward County, County Commissioners – Precincts 1, 2, 3 and 4

The following municipalities will be provided the requisite notice on or before the filing date:

City of Barstow, Mayor
City of Pecos, Mayor

A representative copy of the written notice, with attached map, that will be provided to the Department of Defense Siting Clearinghouse at the specified email address is included as Attachment No. 15.

D. Provide a copy of the notice that is to be published in newspapers of general circulation in the counties in which the facilities are to be constructed. Attach a list of the newspapers that will publish the notice for this application. After the notice is published, provide the publisher's affidavits and tear sheets.

Notice for this Application will be published in the *Monahans News*, a newspaper of general circulation in Ward County, the *Pecos Enterprise*, a newspaper of general circulation in Reeves County, and the *Fort Stockton Pioneer*, a newspaper of general circulation in Pecos County. A representative copy of the newspaper notices to be published is included as Attachment No. 16.

Proof of publication will be provided in the form of publisher's affidavits and tear sheets following publication of these notices.

For a CREZ application, in addition to the requirements of 16 TAC § 22.52 the applicant shall, not less than twenty-one (21) days before the filing of the application, submit to the Commission staff a "generic" copy of each type of alternative published and written notice for review. Staff's comments, if any, regarding the alternative notices will be provided to the applicant not later than seven days after receipt by Staff of the alternative notices, Applicant may take into consideration any comments made by Commission staff before the notices are published or sent by mail.

Not applicable.

A copy of the Application, in addition to written notice and maps, will be provided to the Texas Office of Public Utility Counsel ("OPUC"). A copy of the notice and maps that will be provided to OPUC is included as Attachment No. 15.

26. Parks and Recreation Areas:

For each route, list all parks and recreational areas owned by a governmental body or an organized group, club, or church and located within 1,000 feet of the center line of the route. Provide a general description of each area and its distance from the center line. Identify the owner of the park or recreational area (public agency, church, club, etc.). List the sources used to identify the parks and recreational areas. Locate the listed sites on a routing map.

After review of federal, state, and local websites and maps, as well as field reconnaissance surveys, no parks or recreational areas owned by a government body or an organized group, club or church were identified to be located within 1,000 feet of any route centerline of the Proposed Transmission Line Project.

See Section 3.7.2, page 3-71 and Section 7.7.2, page 7-16 of the Environmental Assessment and Routing Study, included as Attachment No. 1. Figures 3-1A and 3-1B (map pockets) of Attachment No. 1 depict the location of the parks and recreational areas within the study area.

27. Historical and Archeological Sites:

For each route, list all historical and archeological sites known to be within 1,000 feet of the center line of the route. Include a description of each site and its distance from the center line. List the sources (national, state or local commission or societies) used to identify the sites. Locate all historical sites on a routing map. For the protection of the sites, archeological sites need not be shown on maps.

A review of the maps at the Texas Archeological Research Laboratory and the THC's Archeological Sites Atlas, along with field reconnaissance, were conducted to locate known cultural resources within 1,000 feet of the center line of any route for the Proposed Transmission Line Project. There are no sites within 1,000 feet of the center line of the alternative routes that have been recorded in the National Register of Historical Places. Six cemeteries were identified within the study, but none were identified within 1,000 feet of the center line of any alternative route for the Proposed Transmission Project. A total of nine archaeological sites are located within 1,000 feet of the center line of the alternative routes. The distance from these cultural resources to the closest route link and the corresponding routes are provided in the table below.

Feature ID	Routes	Link	Distance to Link (feet)	Direction to Link
THERE ARE NO CEMETERIES WITHIN 1,000 FEET OF ROUTE				
THERE ARE NO OFFICIAL TEXAS HISTORICAL MARKERS WITHIN 1,000 FEET OF A ROUTE				
ARCHAEOLOGICAL SITES WITHIN 1,000 FEET OF ROUTE				
41WR87	3, 13, 14, 18, 41, 46, 49, 78, 90, 131, 183	B1	730	Southeast
41WR98		B1	100	Northwest

Feature ID	Routes	Link	Distance to Link (feet)	Direction to Link
41RV6	46, 49, 78, 325, 326, 328, 329, 357, 366	D1	0	Crossed by link
41WR85	183	D41	120	South
41RV67	18, 41, 297, 310, 320, 324	F3	80	East
41RV23	90, 183	F5	590	East
41RV42	3, 90, 183, 280, 281, 282	H2	40	East
41RV38		H2	830	East
41RV3	49, 310, 328, 370	K3	0	Crossed by link

See Section 3.8, pages 3-75 through 3-82 and Section 7.8, pages 7-20 through 7-25 of the Environmental Assessment and Routing Study, included as Attachment No. 1.

Figures 3-1A and 3-1B (map pockets) of Attachment No. 1 depict the location of the six cemeteries within the study area.

28. Coastal Management Program:

For each route, indicate whether the route is located, either in whole or in part, within the coastal management program boundary as defined in 31 T.A.C. §503.1. If any route is, either in whole or in part, within the coastal management program boundary, indicate whether any part of the route is seaward of the Coastal Facilities Designation Line as defined in 31 T.A.C. §19.2(a)(21). Using the designations in 31 T.A.C. §501.3(b), identify the type(s) of Coastal Natural Resource Area(s) impacted by any part of the route and/or facilities.

The Proposed Transmission Line Project is not located, either in whole or in part, within the coastal management program boundary as defined in 31 T.A.C. §503.1.

29. Environmental Impact:

Provide copies of any and all environmental impact studies and/or assessments of the project. If no formal study was conducted for this project, explain how the routing and construction of this project will impact the environment. List the sources used to identify the existence or absence of sensitive environmental areas. Locate any environmentally sensitive areas on a routing map. In some instances, the location of the environmentally sensitive areas or the location of protected or endangered species should not be included on maps to ensure preservation of the areas or species.

The Environmental Assessment and Routing Study prepared by Halff is included as Attachment No. 1.

Within seven days after filing the application for the project, provide a copy of each environmental impact study and/or assessment to the Texas Parks and Wildlife Department (TPWD) for its review at the address below. Include with this application a copy of the letter of transmittal with which the studies/assessments were or will be sent to the TPWD.

Texas Parks and Wildlife Department
Director of Wildlife
Mr. Clayton Wolf
4200 Smith School Road
Austin, Texas 78744

The applicant shall file an affidavit confirming that the letter of transmittal and studies/assessments were sent to TPWD.

A copy of the Environmental Assessment and Routing Study will be provided to the Texas Parks and Wildlife Department ("TPWD") for review within seven days following the filing of the Application for the Proposed Transmission Line Project. *See* Attachment No. 18 for a copy of the transmittal letter which will be sent to the TPWD.

30. Affidavit

Attach a sworn affidavit from a qualified individual authorized by the applicant to verify and affirm that, to the best of their knowledge, all information provided, statements made, and matters set forth in this application and attachments are true and correct.

31. List of Attachments to the CCN Application

Attachment No. 1:	Environmental Assessment and Routing Study
Attachment No. 2:	Oncor/AEP Texas Letter Agreement dated October 19, 2018
Attachment No. 3:	Cost Estimates
Attachment No. 4:	ERCOT's June 2018 Endorsement Letter and Independent Review dated May 2018 for the Far West Texas Project 2
Attachment No. 5:	Project Location Map referenced in Application Response #14
Attachment No. 6:	Oncor and AEP Texas Far West Texas Project RPG Submittal Report dated April 2016
Attachment No. 7:	ERCOT's June 2017 Endorsement Letter and Independent Review dated May 2017 for the Far West Texas Project
Attachment No. 8:	Oncor Far West Texas Project 2 RPG Submittal Report dated February 2018
Attachment No. 9:	Critical Status Designation Request Letter dated May 14, 2018
Attachment No. 10:	ERCOT Board of Directors Resolution dated June 12, 2018
Attachment No. 11:	Schematics of Transmission System in Proximate Area of Project
Attachment No. 12:	Routing Memorandum of Brenda J. Perkins
Attachment No. 13:	Copy of Direct Notice to Directly Affected Land Owners
Attachment No. 14:	Mail Out List
Attachment No. 15:	Copy of Direct Notice to Utilities, Counties, Municipalities, OPUC, and Department of Defense Siting Clearinghouse
Attachment No. 16:	Copy of Newspaper Notice
Attachment No. 17:	Copy of Direct Notice to Pipeline Owners/Operators
Attachment No. 18:	Transmittal Letter to TPWD
Attachment No. 19:	Oath

ENVIRONMENTAL ASSESSMENT AND ALTERNATIVE ROUTE ANALYSIS

for the proposed

Sand Lake—Solstice 345 kV Transmission Line Project in Pecos, Reeves, and Ward Counties, Texas

Oncor Electric Delivery Company LLC
&
AEP Texas Inc.

By

NOVEMBER 2018

Printed on 100% post-consumer recycled fiber and Sustainable Forestry Initiative certified fiber. Made in the USA

TABLE OF CONTENTS

APPENDICES

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

A.D.	*anno Domini* (after Christ)
AEP Texas	AEP Texas Inc.
AM	Amplitude Modulation (e.g., AM Tower)
APLIC	Avian Power Line Interaction Committee
ARC	AR Consultants, Inc.
B.C.	Before Christ
BEG	Bureau of Economic Geology
BMP	Best Management Practice
C	Federally Considered ESA Species
CCN	Certificate of Convenience and Necessity
CFR	Code of Federal Regulations
℄	Center Line
CNAH	Center for North American Herpetology
CR	County Road
DM	Federally Delisted or Monitored ESA Species
E	State Endangered Species
e.g.	*exempli gratia* (for example)
EMST	Ecological Mapping Systems Cover Type
EOID	Element Occurrence Identification number
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
ESI	Environmental Science Institute
et al.	*et alia* (and others)
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FM	Farm-to-Market Road (e.g., FM 866)
FM	Frequency Modulation (e.g., FM Tower)
FPPA	Farmland Protection Policy Act
GHM	General Highway Map
GIS	Geographic Information System
GLO	Texas General Land Office
Halff	Halff Associates, Inc.
HPA	High Probability Area
i.e.	*id est* (that is)
IH	Interstate Highway
ISD	Independent School District
kV	kilovolt (1,000 volts)
LE	Federally Listed Endangered Species
LRR	Land Resource Region
LT	Federally Listed Threatened Species
MBTA	Migratory Bird Treaty Act
MLRA	Major Land Resource Area
MLU	Mobile Living Unit
MOU	Mobile Office Unit

ACRONYMS AND ABBREVIATIONS

msl	Mean Sea Level
NAIP	U.S. Department of Agriculture National Agriculture Imagery Program
NDD	Natural Diversity Database
NGS	National Geographic Society
NHD	National Hydrology Data Set
NRCS	Natural Resources Conservation Service (an agency of the USDA)
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWP	Nationwide Permit
Oncor	Oncor Electric Delivery Company LLC
OTHM	Official Texas Historical Markers
PCN	Pre-construction Notification
PUCT	Public Utility Commission of Texas
RM	Ranch-to-Market (e.g., RM 17)
ROW	Right-of-Way
RRC	Railroad Commission of Texas
SAL	State Antiquities Landmark
SCS	Soil Conservation Service (agency was renamed NRCS, see above)
SFR	Single-Family Residence
SGCN	Species of Greatest Conservation Need
SH	State Highway
sp.	Species
spp.	Species (plural)
SWPPP	Storm Water Pollution Prevention Plan
T	State Listed Threatened Species
TARL	Texas Archeological Research Laboratory
TASA	Texas Archeological Sites Atlas
TDA	Texas Department of Agriculture
TCEQ	Texas Commission on Environmental Quality
THC	Texas Historical Commission
TNMP	Texas-New Mexico Power Company
TNRIS	Texas Natural Resource Information System
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
URS	URS Corporation
U.S.	United States
US	United States Highway
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
U.S. HUD	United States Department of Housing and Urban Development
USNPS	United States National Park Service

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1.0 PROJECT DESCRIPTION

1.1 Scope of the Project

Oncor Electric Delivery Company LLC (Oncor) and AEP Texas Inc. (AEP Texas) propose to construct a double circuit 345 kilovolt (kV) transmission line from the planned Oncor Sand Lake Switch in Ward County and the existing AEP Texas Solstice Switch in Pecos County, Texas. The Sand Lake Switch is located approximately 6 miles northeast of the City of Pecos on the northwest side of Farm-to-Market Road (FM) 3398. The Solstice Switch is located along the north side of Interstate Highway (IH) 10 approximately 2.5 miles east of the Pecos/Reeves County Line. The proposed transmission line project will be approximately 40-50 miles long. Each of these project endpoints is shown relative to the location of the nearby towns and communities and the state and county boundaries on **Figure 1-1**.

Halff Associates, Inc. (Halff) was retained to identify and evaluate alternative routes, and to prepare an Environmental Assessment and Alternative Route Analysis report to support the Oncor and AEP Texas application for a Certificate of Convenience and Necessity (CCN). The routing study conducted is incorporated into this document. This report has been prepared to provide information and address the requirements of Section 37.056(c)(4)(A)-(D) of the Texas Utilities Code, Public Utility Commission of Texas (PUCT) Procedural Rules Section 22.52(a)(4), PUCT Substantive Rules Section 25.101, and the PUCT CCN application form for a proposed transmission line. This report may also be used in support of local, state, or federal permitting activities that may be required for the proposed project.

To assist Halff in the evaluation of the proposed project, Oncor and AEP Texas provided Halff with information regarding the need, construction practices, and right-of-way (ROW) requirements for the proposed project. Oncor and AEP Texas also provided information regarding the engineering and design requirements for the routing study.

The following sections include a description of the proposed project (**Section 1.0**), an explanation of the methodology used to select alternative routes (**Section 2.0**), a description of the existing environmental and social conditions in the study area (**Section 3.0**), and a description of the preliminary alternative routes that were developed by this process (**Section 4.0**). The public involvement program is described in **Section 5.0**, and a discussion of changes to preliminary alternative route links following the receipt of public input and other information is described in **Section 6.0**. An evaluation of expected environmental impacts is presented in **Section 7.0**, followed by a list of report preparers (**Section 8.0**), and bibliographical references used in preparing this report (**Section 9.0**). The appendices include copies of agency correspondence (**Appendix A**), public participation meeting information (**Appendix B**), preliminary route modifications (**Appendix C**), route definitions (**Appendix D**), alternative route environmental data (**Appendix E**), habitable structure data (**Appendix F**), and environmental and land use constraints maps (**Appendix G**).

1.2 Need for the Project

Oncor and AEP Texas will provide support for the purpose and need for the proposed project as a part of the CCN application.

1.3 Description of Proposed Construction

1.3.1 Transmission Line Design

For the proposed project, Oncor and AEP Texas anticipate the use of self-supporting, double-circuit lattice, steel towers (**Figure 1-2** and **Figure 1-3**). Design criteria will comply with applicable statutes, the appropriate edition of the National Electrical Safety Code, and each companies' standard design practices. Oncor's and AEP Texas' typical structure height are anticipated to be 125 and 165 feet respectively, but tower height will vary depending on terrain. The results of site-specific geotechnical and engineering studies will be used to determine the appropriate design and placement of the structures.

1.3.2 Right-of-Way Requirements

The proposed ROW width for the proposed project will be approximately 160 feet. The ROW normally extends an equal distance on both sides of the transmission line centerline. Additional ROW may be required at line angles, dead ends, or for terrain-related constraints.

1.3.3 Clearing Requirements

All brush and undergrowth within the ROW will be removed and maintained. For areas requiring hand clearing, vegetation will be cut level with the ground. No stump exceeding

2 inches above the ground will remain. Any tree located in a fence line having a diameter greater than 4 inches will be cut even with the top of the fence. In the event that stumps are located on hillsides or uneven ground, stumps will be cut where a mowing machine can pass over the ROW without striking any stumps, roots, or snags.

1.3.4 Support Structure Assembly and Erection

Foundations for the lattice steel towers will be completed before erecting the structures. Four holes will be augured into the ground (one hole per tower footing) at each tower location as illustrated in **Figure 1-2** and **Figure 1-3**. The holes will be filled with steel-reinforced concrete to form piers. Stub angles for anchoring the tower will be embedded at the center of the concrete foundations.

Each lattice steel tower will be assembled on the ground near its designed location. Tower assemblies will then be lifted by crane and aligned with and attached to foundation stub angles with structure arms oriented perpendicular to the transmission line centerline. For angle structures, towers will be set with structure arms oriented on the angle bisector.

1.3.5 Conductor Stringing

Once a series of structures has been erected along the transmission line centerline, the conductor stringing phase can begin. Specialized equipment will be attached to properly support and protect the conductor during the pulling, tensioning, and sagging operations. Once conductors and shield wire are in place and tension and sag have been verified, conductor and shield wire hardware is installed at each suspension point to maintain conductor position. Conductor stringing continues until the transmission line construction is complete. All construction equipment will be removed. All temporary culverts and environmental controls previously installed will be removed.

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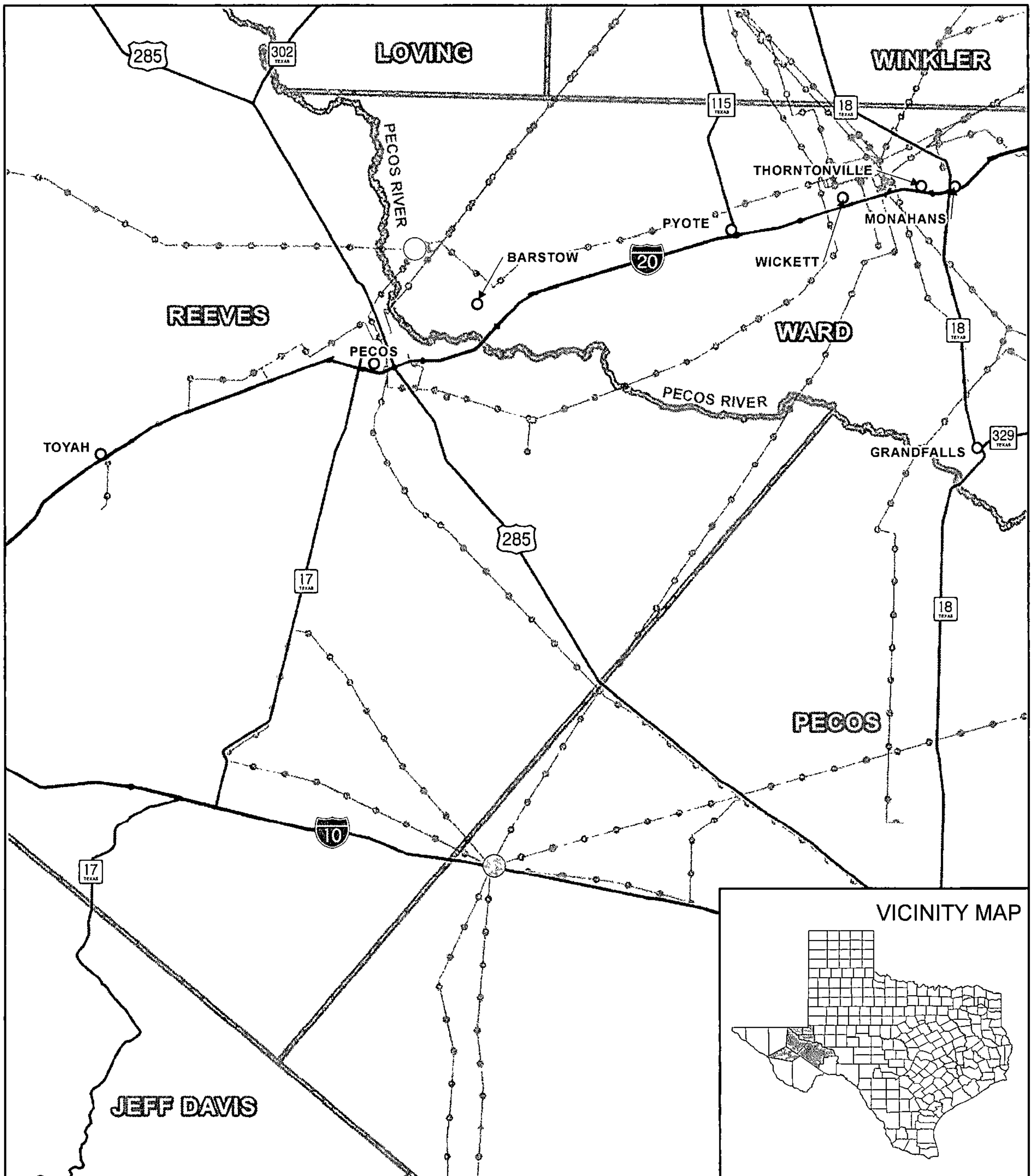

FIGURE 1-1. PROJECT LOCATION MAP

SAND LAKE–SOLSTICE
345 kV TRANSMISSION LINE PROJECT

SAND LAKE SWITCH   SOLSTICE SWITCH   EXISTING TRANSMISSION LINE

0 5 10 20
SCALE IN MILES

ONCOR. AEP TEXAS An AEP Company

BASE MAP TEXAS NATURAL RESOURCES INFORMATION SYSTEM (TNRIS), 2018

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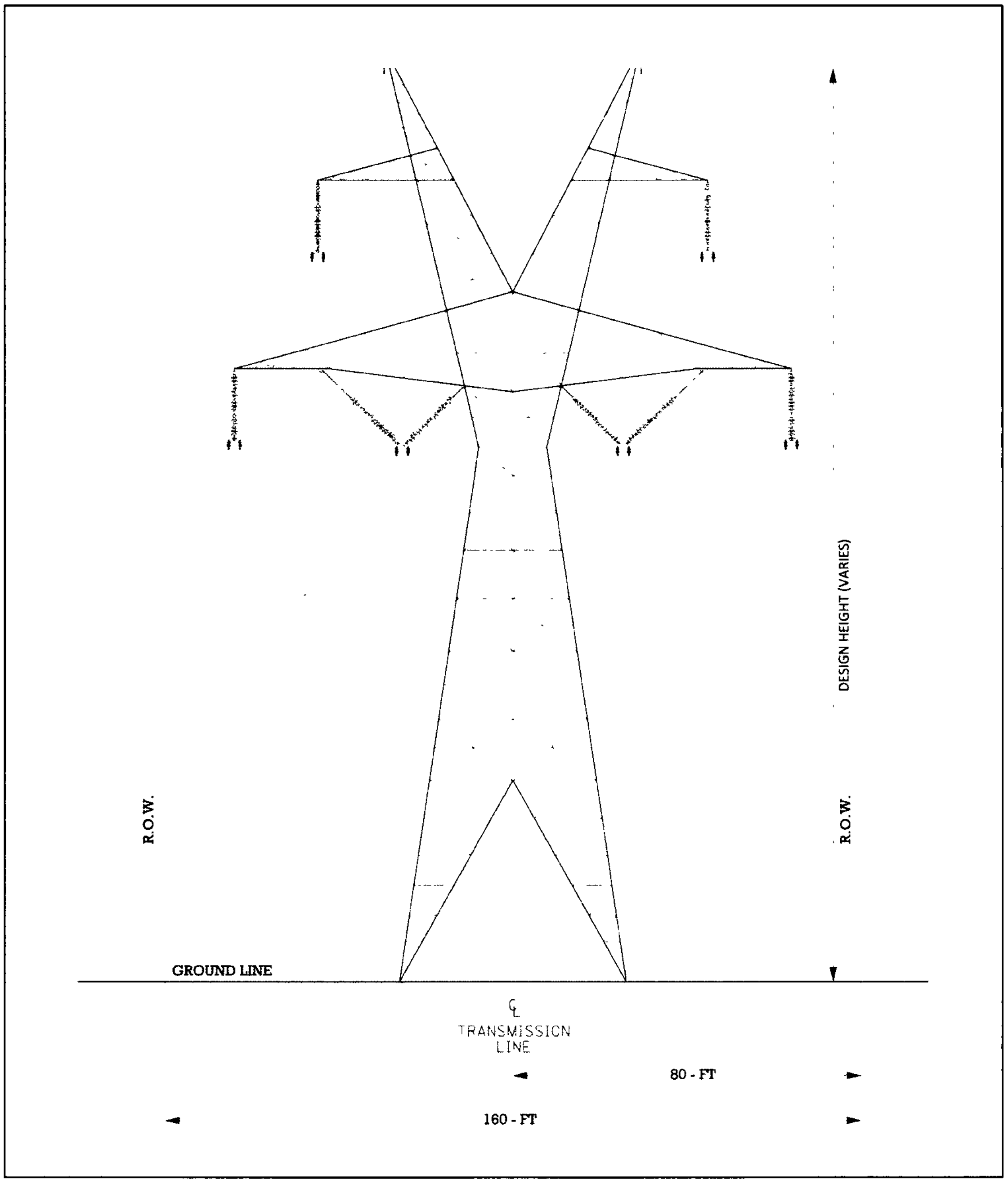

FIGURE 1-2. TYPICAL ONCOR 345 KV DOUBLE-CIRCUIT LATTICE STEEL TOWER*

SAND LAKE—SOLSTICE

345 kV TRANSMISSION LINE PROJECT

— FIGURE NOT TO SCALE —

*345 kV double-circuit lattice steel tower graphic provided by Oncor; all distances are approximate

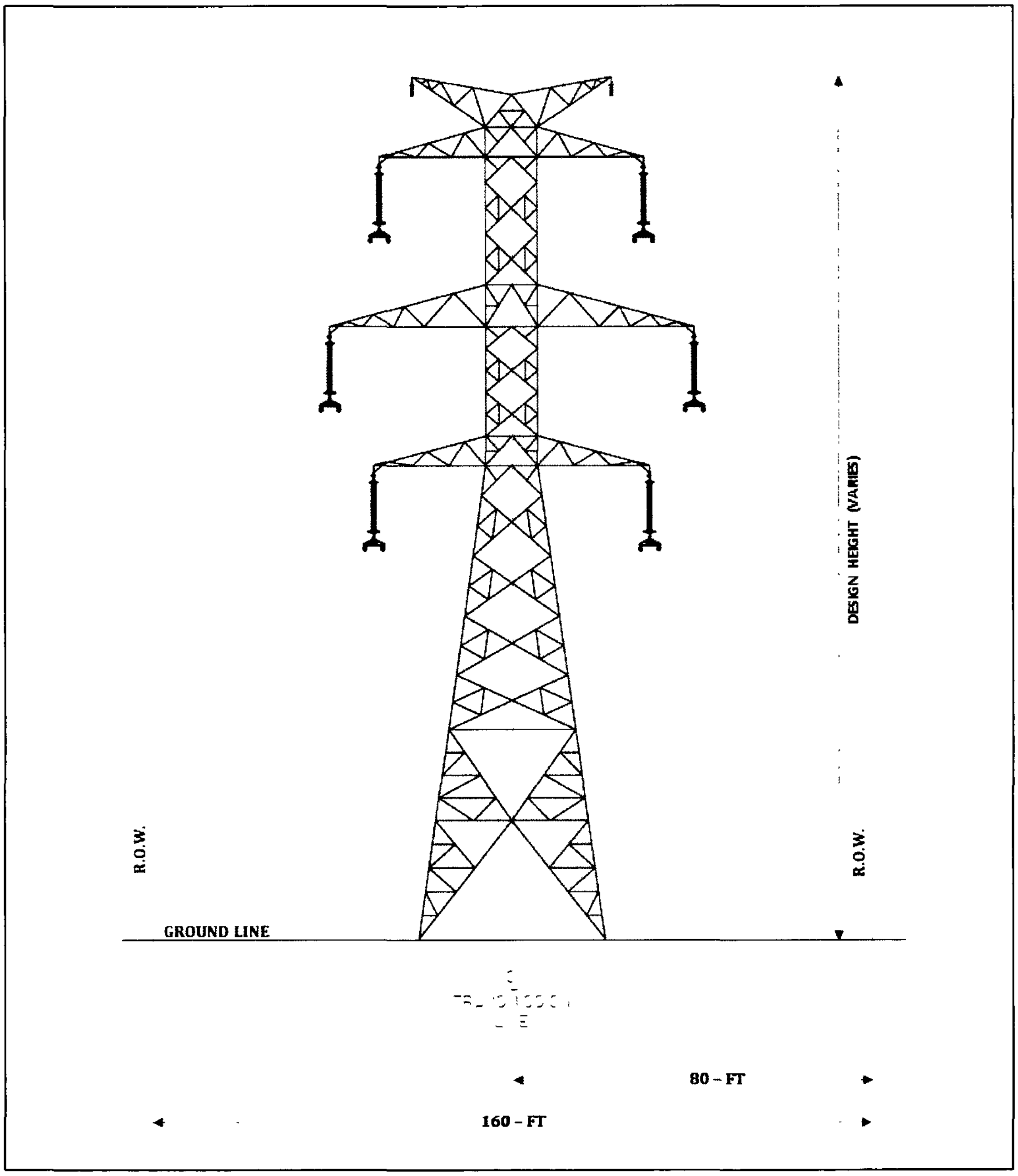

FIGURE 1-3. TYPICAL AEP TEXAS 345 KV DOUBLE-CIRCUIT LATTICE STEEL TOWER*

SAND LAKE—SOLSTICE

345 kV TRANSMISSION LINE PROJECT

— FIGURE NOT TO SCALE —

*345 kV double-circuit lattice steel tower graphic provided by AEP Texas;
all distances are approximate

2.0 ROUTE SELECTION METHODOLOGY

The objective of the routing study is to identify and evaluate alternative transmission line routes for the proposed project. Throughout this report, the terms "environment" or "environmental" are used to include the human environment, as well as the natural environment. Halff utilized a comprehensive transmission line routing methodology to identify and evaluate alternative transmission line routes. Potential routes were identified and evaluated in accordance with Section 37.056(c)(4)(A)-(D) of the Texas Utilities Code, PUCT Substantive Rules Section 25.101, including the PUCT policy of prudent avoidance, PUCT Procedural Rules Section 22.52(a)(4), and the PUCT CCN Application Form for a Proposed Transmission Line.

The following subsections provide a description of the route selection methodology, including study area delineation, data collection, reconnaissance surveys, constraints mapping, identification of preliminary alternative routes, public involvement program, adjustment of preliminary alternative routes following field review and the public participation meeting, and evaluation of the alternative routes.

2.1 Study Area Delineation

The first step in the identification of alternative routes was to define a study area. This area needed to encompass the proposed termination points (e.g., the Solstice Switch in Pecos County) and include an area large enough that a reasonable number of forward progressing, geographically diverse alternative routes could be identified. The purpose of delineating the study area for the proposed project was to establish boundaries and limits for the information gathering process (i.e., identifying environmental and land use constraints). The delineation of the study area also allowed Halff to focus its evaluation within a specific area.

Halff reviewed U.S. Geological Survey (USGS) 1:24,000 scale topographic maps (USGS, 1961 – 1981) and aerial photography (DigitalGlobe, 2016; 2017) to develop and refine the study area boundary for the proposed project. Halff located and depicted the project endpoints on the various maps and identified major features in the study area, such as IH 10, IH 20, United States Highway (US) 285, State Highway (SH) 17, the City of Pecos, and various towns and communities located in the vicinity. **Figure 2-1** shows the study area boundary Halff delineated overlain on aerial photography and general constraints from the above-described process. **Figure 2-2** provides a more detailed map of the study area. The study area is an irregular shape with the longer axis (approximately 38 miles) aligned north-to-south. Both the northern and southern halves, as shown in **Figure 2-2**, are approximately 25 miles wide east-to-west.

2.2 Data Collection

2.2.1 Solicitation of Information from Local, State, and Federal Officials and Agencies

Once the study area boundary was identified, Halff initiated a variety of data collection activities. One of the first such activities was the development of a list of officials to whom a consultation letter regarding the proposed project would be mailed. The purpose of the consultation letters was to inform the various officials and agencies of the proposed project and give them the opportunity to provide information they may have regarding the study area. Halff utilized the Texas Municipal League and other regional planning websites, as well as confirmation via telephone calls, to identify incorporated cities and towns within and near the study area and identify the local officials within each city or town. State and federal agencies that may have potential permitting requirements for, or other interests in, the proposed project were also identified. Correspondence was sent to the following federal or state agencies, and local officials and departments. Copies of all correspondence to and from these agencies are included in **Appendix A**.

FEDERAL AGENCIES

- Federal Aviation Administration (FAA) – Southwest Division
- Federal Emergency Management Agency (FEMA)
- Natural Resources Conservation Service (NRCS)
- U.S. Army Corps of Engineers (USACE) – Albuquerque District
- U.S. Department of Defense (DoD Siting Clearinghouse)
- U.S. Fish and Wildlife Service (USFWS) – Austin Field Office

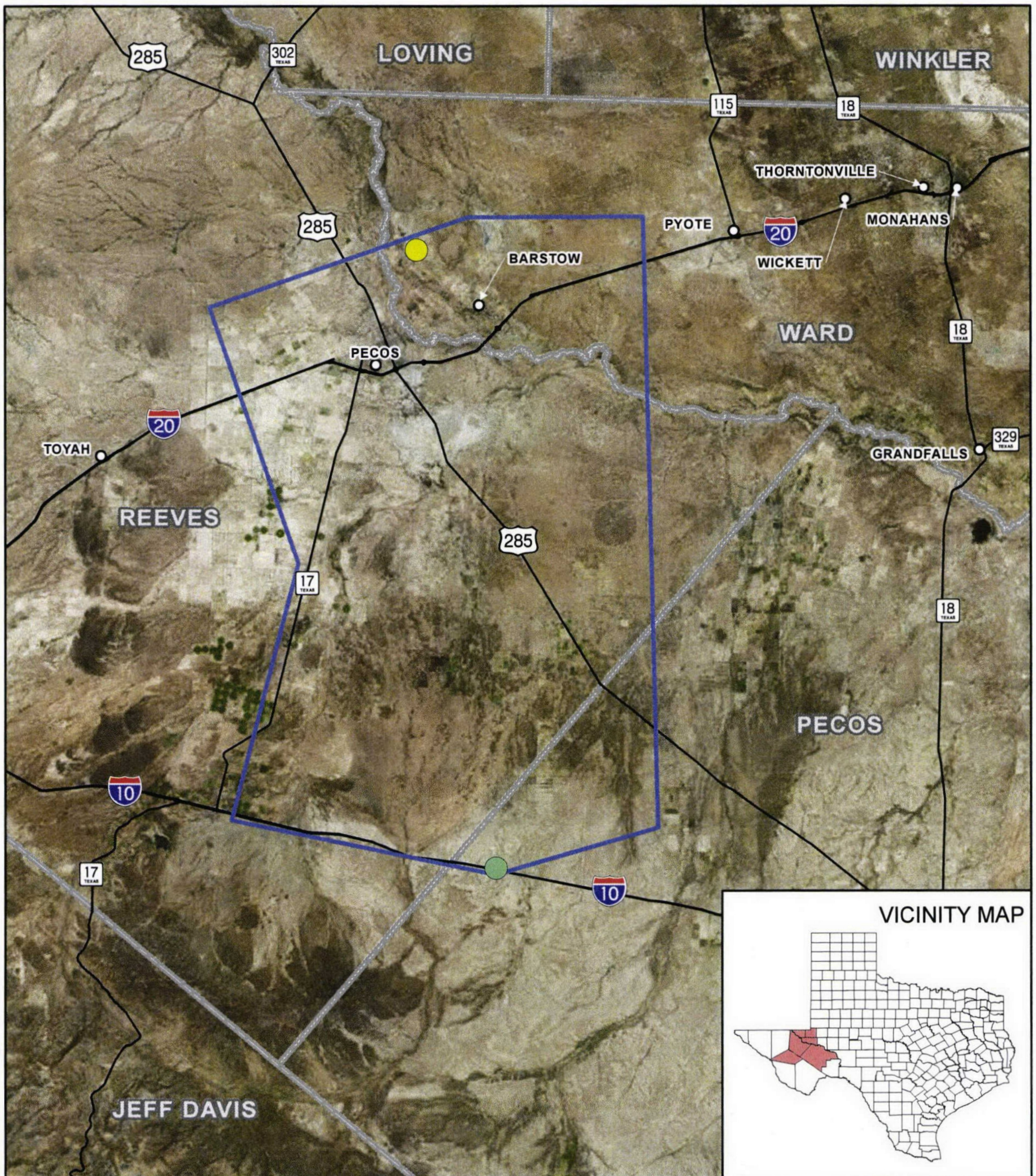

FIGURE 2-1. PROJECT AREA MAP

SAND LAKE – SOLSTICE
345 kV TRANSMISSION LINE PROJECT

SAND LAKE SWITCH SOLSTICE SWITCH STUDY AREA

0 5 10 20
SCALE IN MILES

BASE MAP: DIGITALGLOBE, 2016; 2017

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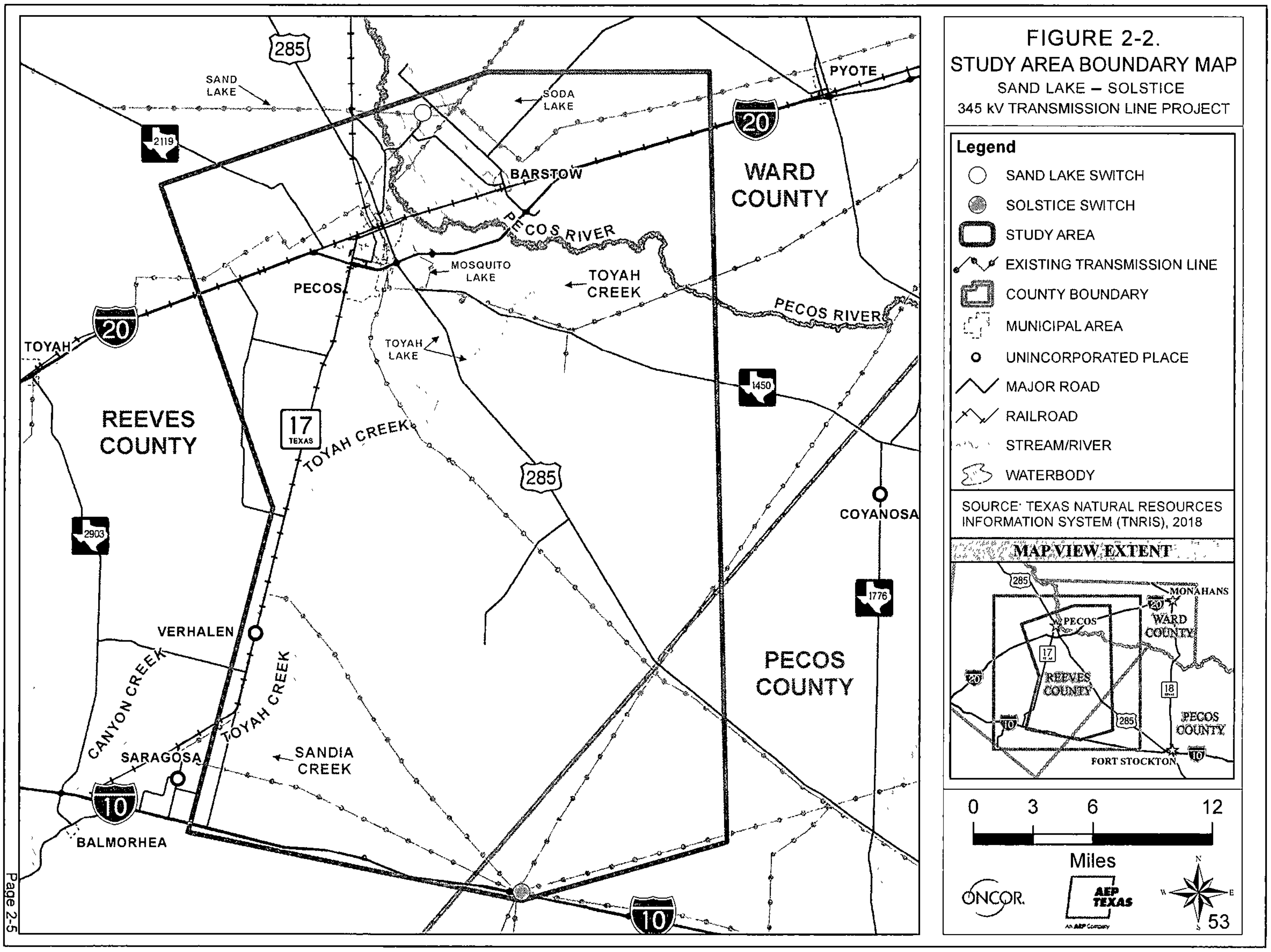
FIGURE 2-2.
STUDY AREA BOUNDARY MAP
SAND LAKE – SOLSTICE
345 kV TRANSMISSION LINE PROJECT
Legend
SAND LAKE SWITCH
SOLSTICE SWITCH
STUDY AREA
EXISTING TRANSMISSION LINE
COUNTY BOUNDARY
MUNICIPAL AREA
UNINCORPORATED PLACE
MAJOR ROAD
RAILROAD
STREAM/RIVER
WATERBODY
SOURCE: TEXAS NATURAL RESOURCES INFORMATION SYSTEM (TNRIS), 2018
MAP VIEW EXTENT
0 3 6 12
Miles
ONCOR
AEP TEXAS
53
SAND LAKE
SODA LAKE
PYOTE
WARD COUNTY
BARSTOW
PECOS RIVER
MOSQUITO LAKE
TOYAH CREEK
PECOS
TOYAH
TOYAH LAKE
REEVES COUNTY
TOYAH CREEK
COYANOSA
VERHALEN
CANYON CREEK
SARAGOSA
SANDIA CREEK
BALMORHEA
PECOS COUNTY
285
20
2119
1450
17
2903
1776
10
MONAHANS
FORT STOCKTON
18

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STATE AGENCIES

- Railroad Commission of Texas (RRC)
- Texas Archeological Research Laboratory (TARL)
- Texas Department of Transportation (TxDOT) – Aviation Division, Odessa District, and Office of Environmental Affairs
- Texas General Land Office (GLO)
- Texas Historical Commission (THC)
- Texas Parks and Wildlife Department (TPWD)
- Texas State Soil and Water Conservation Board
- Texas Water Development Board (TWDB)

REGIONAL OR INDEPENDENT AGENCIES

- Permian Basin Regional Planning Commission

COUNTY AGENCIES

- County Historical Commission – Reeves County and Ward County
- Pecos County Officials (County Judge, County Commissioners)
- Reeves County Officials (County Judge, County Commissioners)
- Reeves County Water Improvement District #1 and District #2
- Ward County Officials (County Judge, County Commissioners)
- Ward County Irrigation District #1
- Ward County Water Improvement District #2

CITY AGENCIES

(includes council members, city staff, and economic development boards)

- City of Barstow
- City of Pecos

SCHOOL DISTRICTS

- Fort Stockton Independent School District (ISD)
- Monahans-Wickett-Pyote ISD
- Pecos-Barstow-Toyah ISD

Other data collection activities included a file and record review of various regulatory agency databases, a review of published literature, and a review of a variety of maps, including recent aerial photography (DigitalGlobe, 2016; 2017), seamless USGS topographic maps (National Geographic Society [NGS], 2016), county highway maps, and county appraisal district land parcel boundary maps. Findings of the data collection activities are detailed in **Section 3.0**.

2.2.2 Reconnaissance Surveys

Halff conducted multiple reconnaissance surveys of the study area to develop and confirm the findings of the above-mentioned research and data collection activities and to identify existing conditions or constraints that may not have been previously noted. Results from the study area visits were also utilized to assist in the alternative route selection process. Ground reconnaissance surveys were conducted by visual observations of study area characteristics from public roads and public ROW located within the study area. Reconnaissance survey information was noted in the field and geographically referenced to digital aerial photography base maps. Reconnaissance surveys (including aerial fly-overs) were conducted on the following dates:

- June 13, 2018
- August 14, 2018
- August 15, 2018
- August 16, 2018
- September 11, 2018

The data collection effort, although concentrated in the early stages of the proposed project, continued up to the point of final development of alternative routes. Results of the various data collection activities (e.g., solicitation of information from local, state, and federal officials and agencies, file/record review, and visual reconnaissance surveys) are included in **Section 3.0** and **Section 7.0** of this report.

2.3 Constraints Mapping

The data and information collected from the activities outlined above were used to develop an environmental and land use constraints map. The constraints map, public maps, aerial photography, reconnaissance surveys, and other research were used to identify and select potential preliminary alternative routes within the study area. In this context, constraints are land use or landscape features that may affect or be affected by the location of a transmission line. The goal of this approach is to identify opportunity areas, which are areas where constraints are absent or fewer, or those areas with a lower likelihood of containing existing natural or human resources that could be negatively affected by a transmission line. For linear projects, crossing over or near certain constraints is often unavoidable. In these instances, special considerations or mitigation measures may be used, even though there is no law or regulation that would otherwise prohibit the proximity of a transmission line.

2.4 Identification of Preliminary Alternative Route Links

Upon completion of initial data collection activities and the constraint mapping process, the next step was to identify preliminary alternative route links to connect the project endpoints. Halff utilized the following sources of information to identify the preliminary alternative routes:

- input received from correspondence with agencies and local officials, as described in **Section 2.2.1**;
- results from the visual reconnaissance surveys of the study area;
- review of recent aerial photography;
- findings of publicly available data collection activities;
- environmental and land use constraints map;
- apparent property boundaries;
- existing compatible corridors;
- locations of existing developments; and
- other information.

Preliminary alternative route links were identified in accordance with Section 37.056(c)(4)(A)-(D) of the Texas Utilities Code and PUCT Substantive Rules Section 25.101, including the PUCT policy of prudent avoidance. The intent was to identify an adequate number of geographically diverse alternative routes, which were environmentally acceptable considering such factors as the following: community values; park and recreation areas; historical and aesthetic values; vegetation, wildlife, and water resources; environmental quality; length of route parallel to or utilizing existing compatible corridors; length of route parallel to apparent property boundaries; and the PUCT policy of prudent avoidance. In addition, Oncor and AEP Texas provided engineering guidance relating to paralleling existing compatible corridors in the study area and setback guidelines for oil and gas wells and wind turbines. The preliminary alternative route links identified by Halff were then presented at a public participation meeting on August 15, 2018. A more detailed discussion of the development of alternative routes is presented in **Section 4.0**.

2.5 Public Involvement Program

Once the preliminary alternative routes were identified, the public participation meeting was held on August 15, 2018 from 4:00 P.M. to 7:00 P.M. at the Reeves County Civic Center. The purpose of the public participation meeting was to:

- solicit comments and input from residents, landowners, public officials, and other interested parties concerning the proposed project, preliminary alternative routes, and the overall transmission line routing process;
- promote a better understanding of the proposed project including the need, purpose, potential benefits, potential impacts, and the CCN certification process;
- inform the public regarding the routing process, schedule, and the decision-making process; and
- identify the values and concerns of the public and community leaders.

Oncor (after receiving input from AEP Texas) mailed a written notice of the public participation meeting to owners of property crossed by or within 500 feet of the centerline of the preliminary alternative routes. In addition, advertisements were published in local newspapers announcing the location, time, and purpose of the meeting. A summary of the newspapers in which public meeting notices were published and the dates of publication are shown in **Table 2-1**, and a copy of the notice can be found in **Appendix B**.

TABLE 2-1. NEWSPAPERS AND PUBLICATION DATES FOR NOTICES OF PUBLIC PARTICIPATION MEETING.

Newspaper	Publication Date
Fort Stockton Pioneer	August 9, 2018
Monahans News	August 9, 2018
Pecos Enterprise	August 9, 2018

At the public participation meeting, Oncor, AEP Texas, and Halff set up information stations in the meeting room. Each station was devoted to a particular aspect of the proposed project and was staffed by Oncor, AEP Texas, TRC Solutions, Inc. (a land and title research firm), and/or Halff representatives. Each station had maps, illustrations, photographs, and/or text explaining each topic. Interested citizens and property owners were encouraged to visit each station so that the entire process could be explained in the general sequence of project development. The information station format is advantageous, because it allows attendees a chance to receive the information in a relaxed manner and allows them to focus on their particular area of interest and ask specific questions. Furthermore, the one-on-one discussions with Oncor, AEP Texas, Halff, and the other representatives encouraged more interaction from those who might be hesitant to speak out in a speaker/audience forum.

Upon entering, visitors were asked to sign in and were handed an information packet, including an explanation of the proposed project, a map of preliminary alternative route links, and a questionnaire. The information packet also included answers to frequently asked questions, a drawing of both Oncor and AEP Texas' proposed typical transmission towers, and a flow chart that detailed the CCN certification process for new transmission lines. The questionnaire solicited comments on the proposed project, as well as an evaluation of the information presented at the public participation meeting. Copies of the information packet and questionnaire can be found in **Appendix B**.

Halff reviewed and evaluated the responses to the one questionnaire that was submitted at the meeting. The attendee's comment was considered and factored into the overall evaluation of the alternative routes.

2.6 Adjustments of Alternative Route Links Following the Public Participation Meeting

Following the public participation meeting, modifications were made to several of the links presented at the public meeting. The modifications and addition of links were the result of Halff's further evaluation of the preliminary alternative route links. The modified route links are located throughout the study area and are further described and discussed in **Section 6.0**.

2.7 Evaluation of the Alternative Routes

Possible alternative route combinations were recalculated after making the route link adjustments noted above, and then evaluated in detail. The analysis of the alternative routes presented in **Section 7.0** involved the inventory and tabulation of data related to multiple environmental and land use evaluation factors. Many of these factors relate to natural and man-made features that would be crossed by an alternative route (e.g., number of stream crossings, length across cropland, etc.). Some of the evaluation factors include features that are counted or measured if an alternative route link would be within a specified distance of a feature (e.g., airports or communication towers). Other factors included the length of an alternative route that runs parallel to and/or utilizes existing compatible corridors, such as electric transmission lines and public roads. The number or amount of each factor was determined primarily by reviewing recent aerial photography within a Geographic Information System (GIS) mapping program, and, where possible, verified by visual observations during field reconnaissance.

3.0 ENVIRONMENTAL SETTING OF THE STUDY AREA

3.1 Constraints Mapping

Halff identified environmental and land use constraints within the study area. A constraints map was developed that identifies the locations of environmentally sensitive areas and other land use constraints, all of which are mapped on an aerial photograph base map shown on **Figures 3-1A** and **3-1B** (located in **Appendix G**). The information obtained and reviewed in completing the routing study, and the environmental and land use constraints depicted in these figures, are described in detail in the following sections.

3.2 Physiography and Geology

The study area generally centers south of the Pecos River in west Texas, south of the New Mexico-Texas state boundary. The study area lies in the Southern High Plains subregion of the High Plains physiographic region (or "province") that eventually grades into the Edwards Plateau (Bureau of Economic Geology [BEG], 1996). As shown in **Figure 3-2**, alluvium, fluviatile terrace deposits, caliche, and windblown sand deposits including sand sheets and dunes typify most surface geology throughout the study area. The majority of the study area consists of alluvium deposits, whereas terrace deposits centralize along the Pecos River and Toyah Creek and also with caliche, windblown sand, the Tahoka Formation, and the Dockum Group. The eastern portion consists of alluvial and other Quaternary, intermixed with Maxon Sandstone and Glen Rose Limestone, the Dockum Group, and the Gatuna Formation. The southern edge of the study area includes alluvial fan and the Washita Group deposits. There are a few outcrops of gypsite within the study area (Spearing, 1991; BEG, 1996).

Rocks and unconsolidated deposits from the Triassic, Cretaceous, and Quaternary geologic periods are represented in the study area. The Triassic period deposits consist of the Dockum Group outcrops which are observed near the terrace and alluvium deposits in association with the Pecos River and near the Maxon Sandstone and Glen Rose Limestone positioned in the central portion of the study area (Garza and Wesselman, 1962). The Dockum Group is comprised mainly of shale and siltstone with minor amounts of sandstone and gravel (BEG, 1976). The Cretaceous period deposits consist of the Maxon Sandstone and Glen Rose Limestone and the Washita Group, which is mainly located in the southern region of the study area. The Maxon Sandstone and Glen Rose Limestone is comprised of a fine to coarse grained sandstone with secondary amounts of limestone, and its assemblages orient laterally and trend north to south. The Washita Group is comprised mainly of limestone and marl (Garza and Wesselman, 1962; BEG, 1976). The Quaternary period deposits within the study area primarily consist of alluvial sands, older alluvial deposits (mainly gravels), the Tahoka Formation, and the Gatuna Formation (USGS and BEG, 1992; BEG, 1996). Quaternary period geologic features are consolidated and unconsolidated deposits from wind or alluvial processes occurring over the past two million years. Windblown sand, observed mainly in the central region of the study area, is made up of fine to medium grained quartz and feathers out locally (BEG, 1976).

Sand (and silt) sheets are primarily observed in the northern portion of the study area, surrounding terrace deposits of the Pecos River. Terrace deposits include gravel, sand, and silt while alluvium deposits are comprised of sandy silts and are modified by local geology. Caliche, comprised of gravel, sand, and calcium carbonate found in especially dry areas, is observed throughout the northern windblown sand region north of the Pecos River in the study area and is also observed laterally along the Dockum Group near the City of Barstow. Locally isolated in the western region of the study area, with the largest deposit residing north of the City of Pecos, are gypsite deposits, which are granular varying in age. The Gatuna Formation is observed near the Pecos River and the central portion of the study area, typically surrounding older alluvial deposits. The formation is primarily comprised of sandstone and secondary quantities of conglomerate, marl, and gypsum (BEG, 1976).

The topography of the study area is gently sloping towards the Pecos River floodplain, which is wide and flat. The Pecos River and floodplain are oriented northwest to southeast. The Southern High Plains province generally has an elevation of approximately 3,000 feet above mean sea level (msl; BEG, 1996). The elevation of the study area ranges from 2,550 feet above msl along the Pecos River, to 3,300 feet above msl near the southern edge of the study area (Texas Natural Resources Information System [TNRIS], 2018).

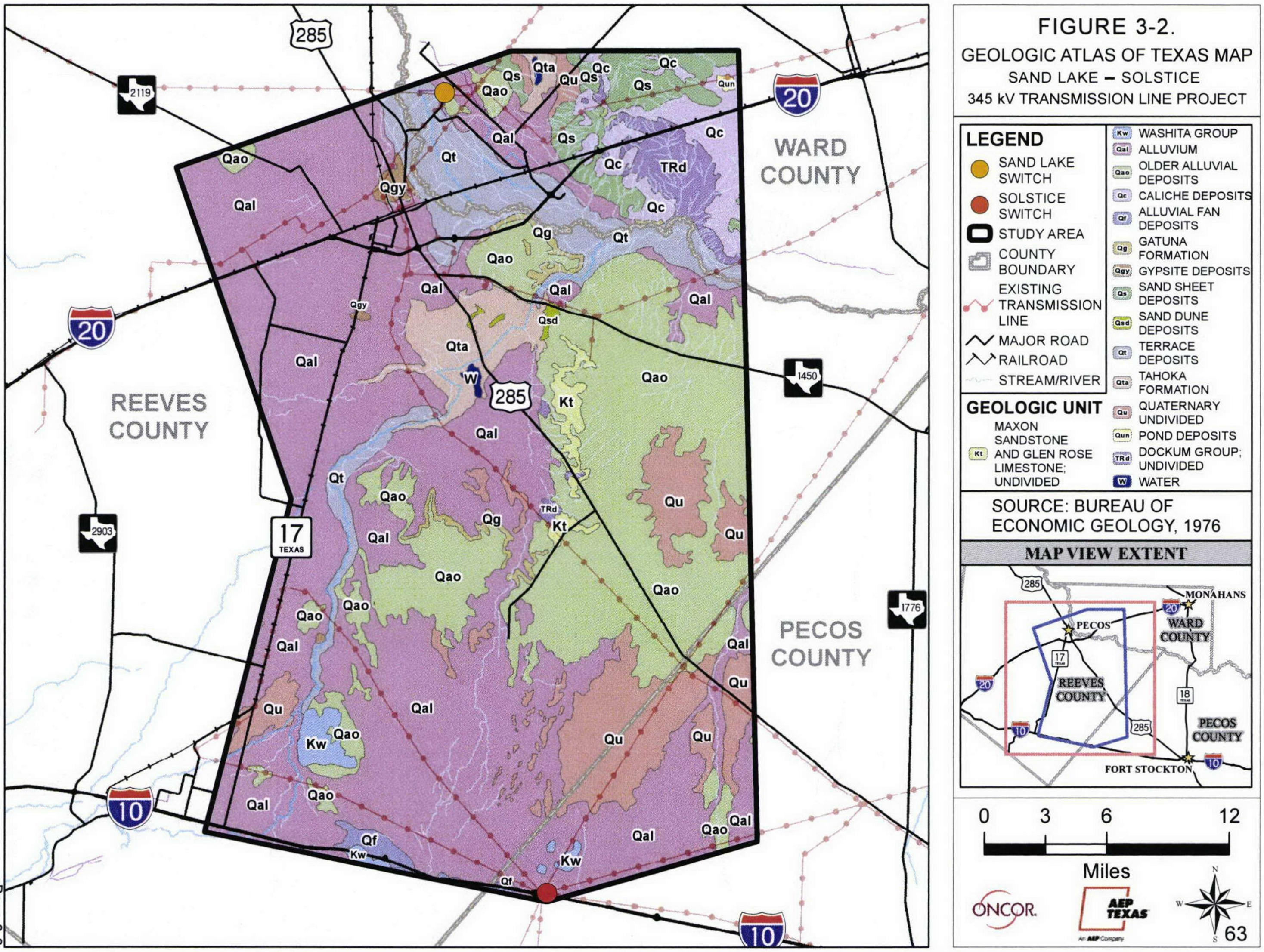

FIGURE 3-2.
GEOLOGIC ATLAS OF TEXAS MAP
SAND LAKE – SOLSTICE
345 kV TRANSMISSION LINE PROJECT

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3.3 Soils

3.3.1 Soil Associations

Data from the NRCS (formerly the Soil Conservation Service [SCS]) were used to identify and characterize the soils that encompass the study area. In 2006, the NRCS completed its Digital General Soil Map of the United States, which consists of a broad inventory and mapping of general soil association units. Soil associations are main patterns of soils defined and delineated based on criteria, such as soil texture, parent material, slope, characteristics of horizons in soil profile, and degree of erosion (NRCS, 2018). The NRCS project merged soil association data from the myriad of county soil surveys into a seamless national data set. This soil mapping approach resolved a basic challenge in using individual county soil surveys, which often reflect different soil names for similar soils from one county to the next. A brief description of each soil association's general characteristics is in **Table 3-1**, and **Figure 3-3** shows the NRCS-mapped soil associations within the study area. The soil associations in the seamless NRCS map were compared graphically with the soil associations defined and mapped in the county-level soil surveys for Pecos, Reeves, and Ward counties (NRCS, 2018; SCS, 1975-1980), and the column on the right side of **Table 3-1** shows the names of the corresponding soil association(s) from each county soil survey, where applicable.

TABLE 3-1. SOIL ASSOCIATIONS WITHIN THE STUDY AREA.

Soil Association Map Unit # - Name [1]	Study Area %	Description of Soil Association [2]	County Soil Survey: Soil Association Name [3]
s7280 – Reakor-Nickle-Delnorte	35.2	Shallow and deep, nearly level to rolling to gently undulating, gravelly and loamy soils; on hills and ridges of uplands	Pecos. Reakor-Upton-Delnorte Reeves: Delnorte-Reakor
s7373 – Reeves-Reagan-Orla-Monahans-Hoban	8.0	Deep and moderately deep, nearly level and gently sloping, well-drained, loamy soils; on uplands	Reeves: Hoban-Reeves-Reakor
s7375 – Reeves-Holloman-Gypsum land	0.2	Loamy, nearly level to gently sloping soils	Ward: Monahans-Ima
s7442 – Rock outcrop-Lozier	0.6	Deep, nearly level and gently sloping, moderately well-drained and well-drained, clayey, and loamy soils; on outwash plains	Reeves: Verhalen-Reakor
s7445 – Upton-Reakor-Lozier	0.2	Shallow to deep soils, well-drained on very gravelly and stony loamy soils, hills to gently sloping; on limestone hills, rock outcrops	Pecos. Lozier-Rock Outcrop Reeves: Lozier-Ector

Soil Association Map Unit # - Name [1]	Study Area %	Description of Soil Association [2]	County Soil Survey: Soil Association Name [3]
s7483 – Monahans-Ima-Hodgins	2 0	Loamy, nearly level to gently sloping soils on uplands	Ward Monahans-Ima
s7519 – Saragosa-Orla	14.7	Shallow, nearly level and gently sloping, well-drained and poorly drained, saline, loamy soils; on uplands	Reeves· Orla-Saragosa
s7542 – Pecos-Patrole-Gila-Arno	5 1	Deep, nearly level, moderately well-drained, saline, loamy and clayey soils; on floodplains	Reeves· Arno-Pecos-Patrole Ward· Arno-Gila
s7577 – Wickett-Sharvana-Pyote	0.8	Well drained, sandy, and loamy soils on uplands	Ward: Pyote, Delnorte-Sharvanna
s7646 – Wickett-Simona-Sharvana-Delnorte	6.8	Well drained, nearly level to undulating, loamy and gravelly soils on uplands	Ward: Delnorte-Sharvarna
s7706 – Verhalen-Toyah-Reakor-Delnorte-Dalby	26.4	Deep, nearly level, moderately well-drained, saline, loamy and clayey soils; on outwash plains and floodplains	Pecos: Dalby-Reakor Reeves: Verhalen-Reakor, Toyah-Bigetty-Balmorhea

Sources: (NRCS, 2018, SCS, 1975-1980)
Notes:
[1] Map unit # and name correspond with the number and name assigned to each association in the 2006 NRCS Digital General Soil Map of the U S , as shown for the study area in **Figure 3-3**.
[2] The description used for the soil association is a composite of the descriptions for the soil associations from individual county soil surveys that correspond geographically with the 2006 NRCS Digital General Soil Map.
[3] This column shows the soil association names from the county soil surveys that correspond to the 2006 NRCS Digital General Soil Map

There are 11 different soil associations within the study area, two of which are associated with floodplains (i.e., Pecos-Patole-Gila-Arno and Verhalen-Toyah-Reakor-Delnorte-Dalby). The surface geology discussed in the previous section is the foundation for the soils found within the study area, and soil maps bear a general similarity with geologic maps of the area. Regardless of the type of underlying bedrock, the upland soils throughout the study area occur in a variety of landscapes, from nearly level, gently sloping, undulating, to rolling topography, consisting of predominantly clayey, loamy, and gravelly texture (NRCS, 2018; SCS, 1975-1980).

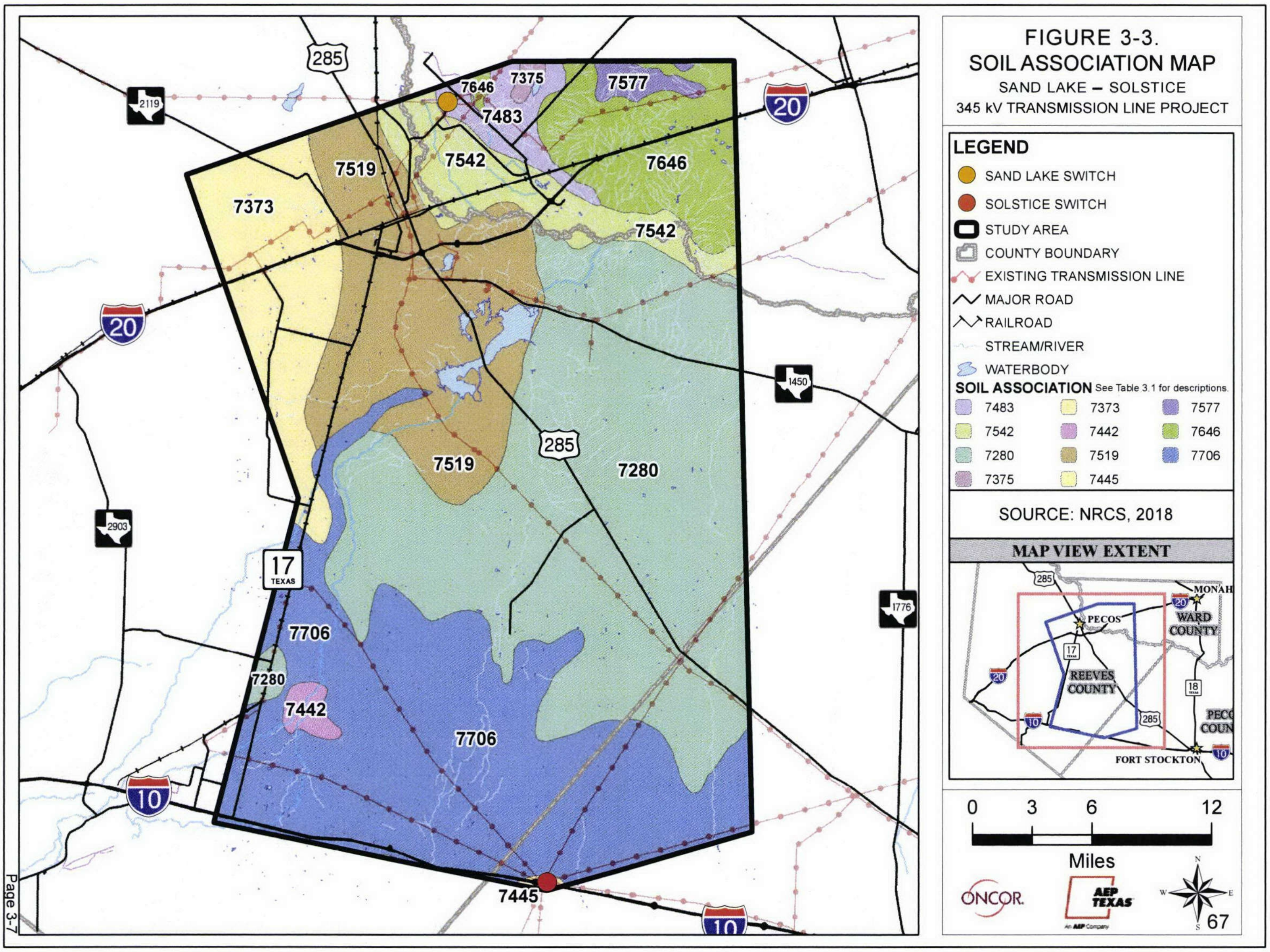
FIGURE 3-3.
SOIL ASSOCIATION MAP
SAND LAKE – SOLSTICE
345 kV TRANSMISSION LINE PROJECT
LEGEND
SAND LAKE SWITCH
SOLSTICE SWITCH
STUDY AREA
COUNTY BOUNDARY
EXISTING TRANSMISSION LINE
MAJOR ROAD
RAILROAD
STREAM/RIVER
WATERBODY
SOIL ASSOCIATION See Table 3.1 for descriptions.
7483
7373
7577
7542
7442
7646
7280
7519
7706
7375
7445
SOURCE: NRCS, 2018
MAP VIEW EXTENT
285
20
PECOS
MONAH
WARD COUNTY
17
REEVES COUNTY
18
10
285
FORT STOCKTON
0 3 6 12
Miles
ONCOR
AEP TEXAS
An AEP Company
N
E
S
W
67
285
2119
20
7646
7375
7577
7483
7519
7542
7646
7373
7542
20
1450
285
7519
7280
2903
17
TEXAS
1776
7706
7280
7442
7706
10
7445
10

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3.3.2 Prime Farmland

In the Farmland Protection Policy Act (FPPA), federal law defines prime farmland as "land that has the best combination of physical and chemical characteristics for producing food, feed fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, ..." (7 U.S. Code Section 4201(c)(1)(A)). Such lands have the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management according to acceptable farming methods. Additional potential prime farmlands are areas with soils that meet most of the requirements of prime farmland but fail, because they lack water management facilities, such as irrigation systems, or they lack sufficient natural moisture; such areas would be regarded as prime farmland if these areas were irrigated. No soils within the study area are classified as prime farmland with or without irrigation systems, according to county soil surveys (NRCS, 2018; SCS, 1975-1980).

When land neither meets the classification for either prime or unique farmland, it may be considered a farmland of statewide importance as determined for the significance in "the production of food, feed, fiber, forage, and oilseed crops" (NRCS, 2018). These areas produce high yields of crops yet do not meet all necessary criteria for prime farmland designation. North of the Pecos River in Ward County, approximately 3,020 acres of soils are classified as farmland of statewide importance within the study area. In the northern half of the study area, there are approximately 6,950 acres of soils classified as farmland of statewide importance when irrigated (NRCS, 2018; SCS, 1975-1980).

3.4 Water Resources

3.4.1 Surface Water and Floodplains

From north to south, the study area lies within the Lower Pecos-Red Bluff Reservoir; Landreth-Monument Draws; Toyah; Salt Draw; Barilla Draw; and Coyanosa-Hackberry Draws sub-basins. The Pecos River is the predominant river within the study area and is a perennial stream that flows south across the northeastern region of the study area, along the boundary between Reeves and Ward counties. As shown on any of the figures in **Section 3.0**, numerous smaller tributaries are common near to the Pecos River. Flow from the dam of Red Bluff Reservoir northwest of the study area is the primary influence on the flow rate of the Pecos River in the region.

The National Hydrology Dataset (NHD) shows numerous small surface water bodies scattered across the study area that vary greatly in size and type. Named surface water bodies in the study area identified by NHD are Soda Lake, Sand Lake, Mosquito Lake, Horseshoe Lake, First Tank, and China Lake. Aerial photography supports that many of these are playa type depressions that may dry up periodically and exhibit wetland characteristics, whereas others are excavations or impoundments along existing drainages.

State legislation in 1997 (see Texas Water Code Section 16.051) modified the state-wide water resources planning process by authorizing regional planning groups to recommend ecologically unique river and stream segments to the Texas State Legislature in regional and state water plans (TWDB, 2017). A primary purpose for this approach is to ensure that future water impoundments do not destroy stream segments that are considered unique under specified designation criteria (see 31 Texas Administrative Code Section 357.8), which include biologic functions and habitat for threatened and endangered species. State designation as ecologically unique would also prevent state agencies or municipalities from acquiring property or easements that would destroy the ecological values forming the basis for the designation. Part of the process for designating ecologically unique stream segments requires regional water planning groups to coordinate with TPWD about candidate stream segments (Freese and Nichols, Inc. and LBG – Guyton Associates, Inc., 2016; TWDB, 2017). The segment of Toyah Creek in Reeves County, a Pecos River tributary, is designated as an ecologically significant stream segment. The Toyah Creek confluence with the Pecos River is located approximately 9 miles east of the City of Pecos in the northeastern corner of the study area. No other stream segments in the study area are designated as ecologically significant under the relevant designation criteria (TPWD, 2002; 2018a).

The Upper Pecos River from a point immediately upstream of the confluence of Independence Creek in Crockett and Terrell counties to the Red Bluff Dam in Loving and Reeves counties is listed for depressed dissolved oxygen in the list of impaired water bodies maintained by the Texas Commission on Environmental Quality (TCEQ) under Section 303(d) of the Clean Water Act (TCEQ, 2014). This includes the Pecos River reach depicted within the study area. No other water quality concerns were identified within the study area.

FEMA has not prepared any Flood Insurance Rate Maps or detailed floodplain analyses for Reeves, Ward, and Pecos Counties, except for the area immediately surrounding incorporated towns and cities. The portion of Ward County in the study area shows the area below Soda Lake to the City of Barstow and the floodplain of the Pecos River as Zone A flood hazard areas (FEMA, 2018).

3.4.2 Groundwater/Aquifer

The Cenozoic Pecos Valley and the Edwards-Trinity (Plateau) are the major aquifers in the study area (TWDB, 2007; George et al., 2011). The Cenozoic Pecos Valley Aquifer extends through much of Reeves and Ward counties. Water bearing sediments include alluvial and windblown deposits in the Pecos River Valley. These sediments fill several structural basins, the largest of which are the Pecos Trough in the west and Monument Draw Trough in the east. Thickness of the alluvial fill reaches 1,500 feet, and freshwater saturated thickness averages about 250 feet. The water quality is highly variable, the water typically being hard, and generally better in the Monument Draw Trough than in the Pecos Trough. Total dissolved solids in groundwater from Monument Draw Trough are usually less than 1,000 milligrams per liter. The aquifer is characterized by high levels of chloride and sulfate in excess of secondary drinking water standards, resulting from previous oil field activities. In addition, naturally occurring arsenic and radionuclides occur in excess of primary drinking water standards. More than 80 percent of groundwater pumped from the aquifer is used for irrigation, and the rest is withdrawn for municipal supplies, industrial use, and power generation (George et al., 2011). Water-level declines in excess of 200 feet historically have occurred in south-central Reeves and northwest Pecos counties, but have moderated since the mid-1970s with the decrease in irrigation pumpage. Ground water that once rose to the surface and flowed into the Pecos River now flows in the subsurface toward areas of heavy pumpage. Consequently, baseflow to the Pecos River has declined (Environmental Science Institute [ESI], 2017).

The Edwards-Trinity (Plateau) Aquifer is a major aquifer of southwest Texas. It extends through 45 counties, including parts of Reeves and Pecos counties. Water bearing sediments include predominantly limestone and dolomite of the Edwards Group and sands of the Trinity Group. Alluvial fill is greater than 800 feet, and freshwater saturated thickness averages 433 feet. Water quality of the aquifer is variable with total dissolved solids ranging from 100 to 3,000 milligrams per liter, typically increasing west through the aquifer. Elevated levels of fluoride can be found within the aquifer, in excess of primary drinking water quality standards. More than two-thirds of groundwater pumped from the aquifer is used for irrigation, and the rest is withdrawn for municipal and livestock use. This aquifer has not faced water-level declines as recharge has kept pace with the low levels of pumping of the aquifer (George et al., 2011).

Other minor aquifers within the study area include the Rustler Aquifer located in Pecos, Reeves, and Ward counties. The Rustler Formation is 250 to 670 feet thick and extends downdip into the subsurface toward the center of the Delaware Basin to the east. Groundwater occurs in partly dissolved dolomite, limestone, and gypsum. Most of the water production comes from fractures and solution openings in the upper part of the formation. Although some parts of the aquifer produce freshwater containing less than 1,000 milligrams per liter of total dissolved solids, the water is generally slightly to moderately saline and contains total dissolved solids ranging between 1,000 and 4,600 milligrams per liter. The water is used primarily for irrigation, livestock, and water-flooding operations in oil-producing areas (George et al., 2011).

The Dockum Aquifer is another minor aquifer that occurs within the study area. This aquifer extends through numerous counties in west Texas and the Panhandle region. The Dockum Group consists of gravel, sandstone, siltstone, mudstone, shale, and conglomerate. The water quality in the aquifer is generally poor, with freshwater in outcrop areas in the east and brine in the western subsurface portions of the aquifer, and the water is very hard. Naturally occurring radioactivity from uranium and radium have resulted in amounts exceeding drinking water standards. Groundwater from the aquifer is used for irrigation, municipal water supply, and oil field waterflooding operations, particularly in the southern High Plains. Water level declines and rises have occurred in different areas of the aquifer (George et al., 2011).

All groundwater resources within the study area are located within the TWDB Groundwater Management Area #3 (TWDB, 2015a). Reeves County comprises the Reeves County Groundwater Conservation District. Pecos County is located within the Middle Pecos Groundwater Conservation District. Ward County is not within any groundwater conservation districts (TWDB, 2015b).

3.5 Ecology

3.5.1 Vegetation

The NRCS has studied the characteristics of ecological regions for decades to better understand the biology and management of natural resources. The NRCS published a handbook in 2006 that maps general Land Resource Regions (LRRs) that share similar geology and land physiography, moisture and climate, and soils characteristics (NRCS, 2006). The study area is entirely located within the Western Range and Irrigated Region LRR. The Western Range and Irrigated Region LRR extends across much of the southwestern U.S. Within this LRR, annual precipitation ranges widely, from 6 inches on some of the plains and in some basins to 42 inches on some of the higher mountains (NRCS, 2006).

As shown in **Figure 3-4**, NRCS soil scientists have further subdivided the LRR within the Major Land Resource Areas (MLRAs). As the criteria used to define both MLRAs and the larger LRRs focus fundamentally on soils and soil-forming factors, the delineation of MLRAs is therefore closely linked to the various soil associations that have been mapped over the past half century. This approach to the study of vegetation focuses on the land potential for supporting natural vegetation or agricultural practices, rather than simply reporting a snapshot of vegetation as it may exist at a single point in time.

The study area is located within the boundary of the Southern Desertic Basins, Plains, and Mountains (MLRA 42). The Southern Desertic Basins, Plains, and Mountains has an average annual precipitation of 8 to 14 inches in the eastern and southern parts of this MLRA, which includes the study area. Most of the rainfall occurs as high-intensity, convective thunderstorms from mid-spring to mid-autumn. This area does not receive significant amounts of winter precipitation. The growing season averages 320 days (NRCS, 2006). The physiography of this MLRA is distinguished by intermontane desert basins and broad valleys bordered by gently sloping to strongly sloping bajadas, alluvial fans, and terraces. The geology of this MLRA is varied, and includes linear, isolated mountain ranges. In the study area, Quaternary and Tertiary continental sediments accumulated to form the aggraded desert plains lying between the mountain ranges. The dominant soil orders in this MLRA are Aridisols, Entisols, Mollisols, and Vertisols. The soils generally are moderately deep to very deep, well-drained, and loamy or clayey.

Some of the soils are shallow or very shallow over a petrocalcic horizon (caliche) or bedrock.

The Southern Desertic Basins, Plains, and Mountains support desert grass-shrub vegetation. The dominant grass species include blue grama (*Bouteloua gracilis*), black grama (*Bouteloua eriopoda*), and sideoats grama (*Bouteloua curtipendula*) on prairie grasslands. On sandier soils, typical vegetation consists of giant dropseed (*Sporobolus giganteus*), mesa dropseed (*Sporobolus flexuosus*), and scattered shrubs, such as sand sagebrush (*Artemisia filifolia*) and yuccas (*Yucca* spp.). Creosotebush (*Larrea tridentata*), tarbush (*Flourensia cernua*), and catclaw acacia (*Senegalia greggii*) grow on gravelly, calcareous soils on footslopes. Giant sacaton (*Sporobolus wrightii*), honey mesquite (*Panicum glandulosa*), desert willow (*Chilopsis linearis*), and brickellbush (*Brickellia* spp.) grow in drainageways and depressions. Two-thirds or more of this area is rangeland of low carrying capacity. Three percent of this MLRA is cropland.

The Ecoregions of Texas Level III and Level IV maps were prepared by a collaborative effort between the U.S. Environmental Protection Agency (EPA), TCEQ, and the NRCS (Griffith et al., 2007). This classification system analyzes the ecoregions at a finer scale than the MLRAs. While the spatial extent may vary in some areas, this general description of the overall vegetation type based on NRCS research is consistent with other regional descriptions of ecological regions in west Texas, including the Ecoregions of Texas maps. Under the Ecoregions of Texas Level III classification, the entire study area is located within the Chihuahuan Deserts ecoregion. The Chihuahuan Deserts ecoregion physiography is generally a continuation of basin and range terrain (excluding the Stockton Plateau) that is typical of the Mojave Basin and Range and the Central Basin and Range ecoregions to the west and north, although the pattern of alternating mountains and valleys is not as pronounced as it is in those neighboring ecoregions. Vegetative cover is predominantly semi-desert and arid shrubland, except for high elevation islands of oak, juniper, and pinyon pine woodland.

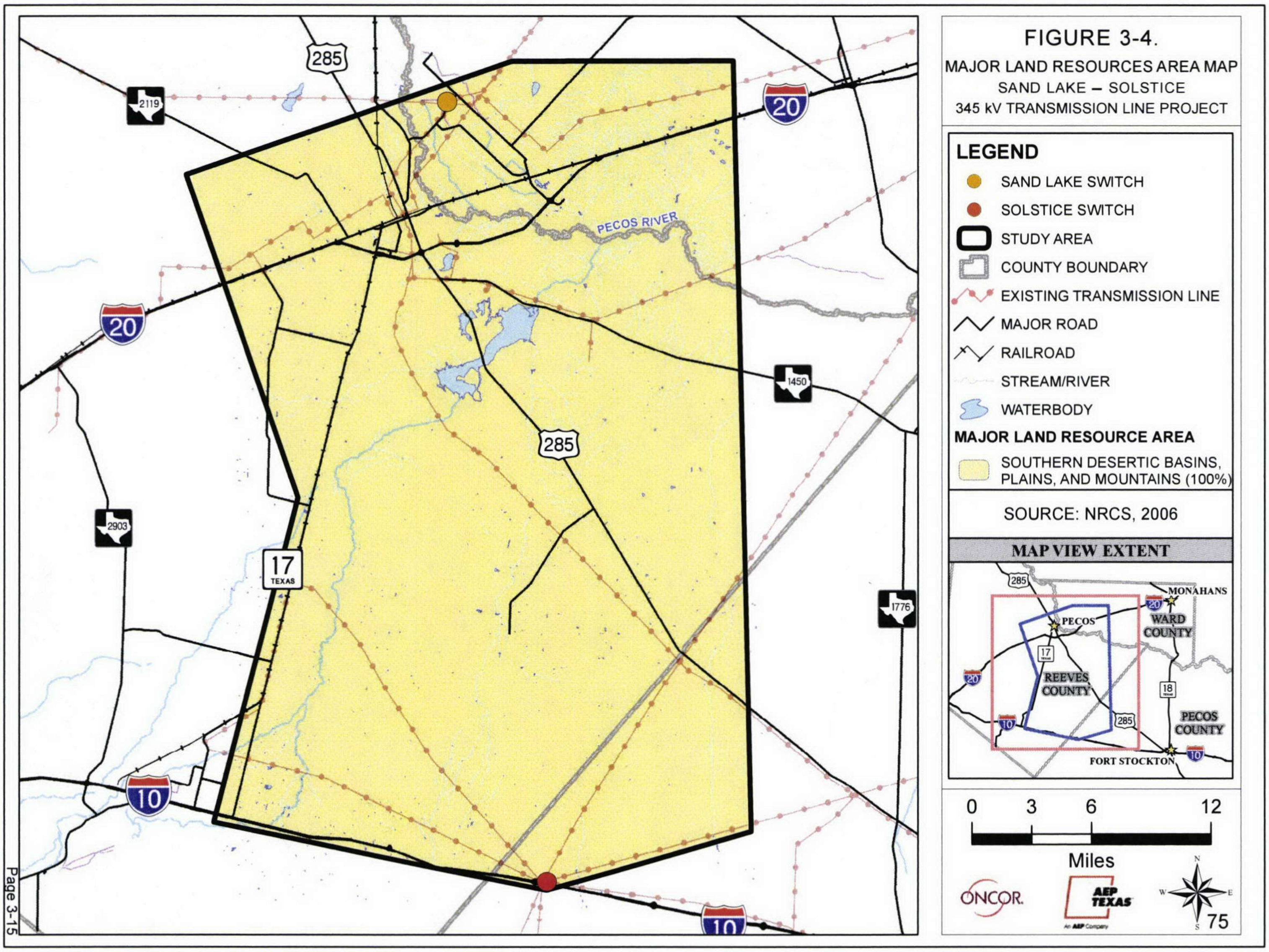

FIGURE 3-4.
MAJOR LAND RESOURCES AREA MAP
SAND LAKE – SOLSTICE
345 kV TRANSMISSION LINE PROJECT
LEGEND
SAND LAKE SWITCH
SOLSTICE SWITCH
STUDY AREA
COUNTY BOUNDARY
EXISTING TRANSMISSION LINE
MAJOR ROAD
RAILROAD
STREAM/RIVER
WATERBODY
MAJOR LAND RESOURCE AREA
SOUTHERN DESERTIC BASINS, PLAINS, AND MOUNTAINS (100%)
SOURCE: NRCS, 2006
MAP VIEW EXTENT
MONAHANS
PECOS
WARD COUNTY
REEVES COUNTY
PECOS COUNTY
FORT STOCKTON
0 3 6 12
Miles
ONCOR
AEP TEXAS
PECOS RIVER
285
20
10
17
1450
2119
2903
1776
75

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At Level IV, the study area is located within the Chihuahuan Basins and Playas ecoregion. The Chihuahuan Basins and Playas ecoregion have saline or alkaline soils and areas of salt flats, dunes, and windblown sand. The typical desert shrubs and grasses growing in these environments, such as creosotebush, tarbush, four-wing saltbush (*Atriplex canescens*), blackbrush (*Vachellia rigidula*), gyp grama (*Bouteloua breviseta*), and alkali sacaton (*Sporobolus airoides*), must withstand large diurnal ranges in temperature, low available moisture, and an extremely high evapotranspiration rate. Saltcedar (*Tamarix* spp.) and common reed (*Phragmites australis*) have invaded riparian areas. Oil and gas production is extensive throughout this ecoregion.

3.5.1.1 Terrestrial Vegetation

GIS data from the TPWD Texas Ecological Mapping System were used to estimate areas of major types of existing vegetation cover within the study area. Data were developed from satellite imagery with 10-meter by 10-meter mapping resolution collected from 2005 to 2007 and refined with in situ data. Using this refined imagery, TPWD created a statewide land cover data set that includes a sufficient number of land cover classes to provide insights for planning and management at a variety of scales (TPWD, 2012). For the purpose of this study, the more specific ecological classifications were grouped into 12 general land cover classes. **Figure 3-5** displays the TPWD land cover data by different land/vegetation cover types, as it was grouped for the purposes of this study.

Use of TPWD land cover digital data yielded the following estimates of cover as applied to the study area: 49 percent shrubland; 27 percent grassland; nine percent salty shrubland (riparian); seven percent salty grassland (riparian); two percent agriculture; two riparian shrubland/woodland; and two percent barren. The remaining cover classes cumulatively account for less than two percent of the total acreage within the study area. This review of land cover in the study area clearly shows that shrubland vegetation dominated by creosotebush and grassland species are the predominant vegetation types. Since a majority of the area is dominated by various types of shrubland, and grassland areas are sparse; cattle ranching and agriculture activities are present, but not widespread.

The description of study area terrestrial vegetation that follows is based on field observations, interpretation of recent aerial photography (DigitalGlobe, 2016; 2017), and a review of reports and maps produced by NRCS (2006), TPWD (1984; 2007), and TCEQ (Griffith et al., 2007). Cover types are provided in the general order as shown on **Figure 3-5**.

The barren cover type includes areas where little or no vegetation cover existed at the time of image data collection. The upland barren cover type is dominated by predominantly unvegetated habitats scattered throughout the northern half of the study area. Outside of these areas, the barren cover type is composed of the Trans-Pecos: Desert Pavement Ecological Mapping Systems Cover Type (EMST) in isolated patches throughout the study area in upland environments. This cover type is largely unvegetated to sparsely vegetated on level to gently rolling, gravelly landscapes over Quaternary alluvium and colluvium flats. These sites often are characterized as having high, harsh temperatures that rise to the development of gravels coated with orange-yellow to black varnish, often referred to as "desert varnish." Creosotebush may be widely scattered. The agriculture cover type consists primarily of irrigated crops in the study area, and is discussed in more detail in **Section 3.5.1.3**. Both cover types are proportionately small compared to other cover types.

Upland grassland or prairie is the second most dominant land cover type found throughout the study area, classified further as upland grassland and sandy grassland, as shown in **Figure 3-5**. These land cover types are composed of five EMST cover types (in order of prevalence):

1. Trans-Pecos: Loamy Plains Grassland;
2. Southwest: Tobosa – Mesquite Grassland;
3. Southwest: Tobosa Grassland;
4. Trans-Pecos Sandy Desert Grassland; and
5. Trans-Pecos: Hill and Foothill Grassland.

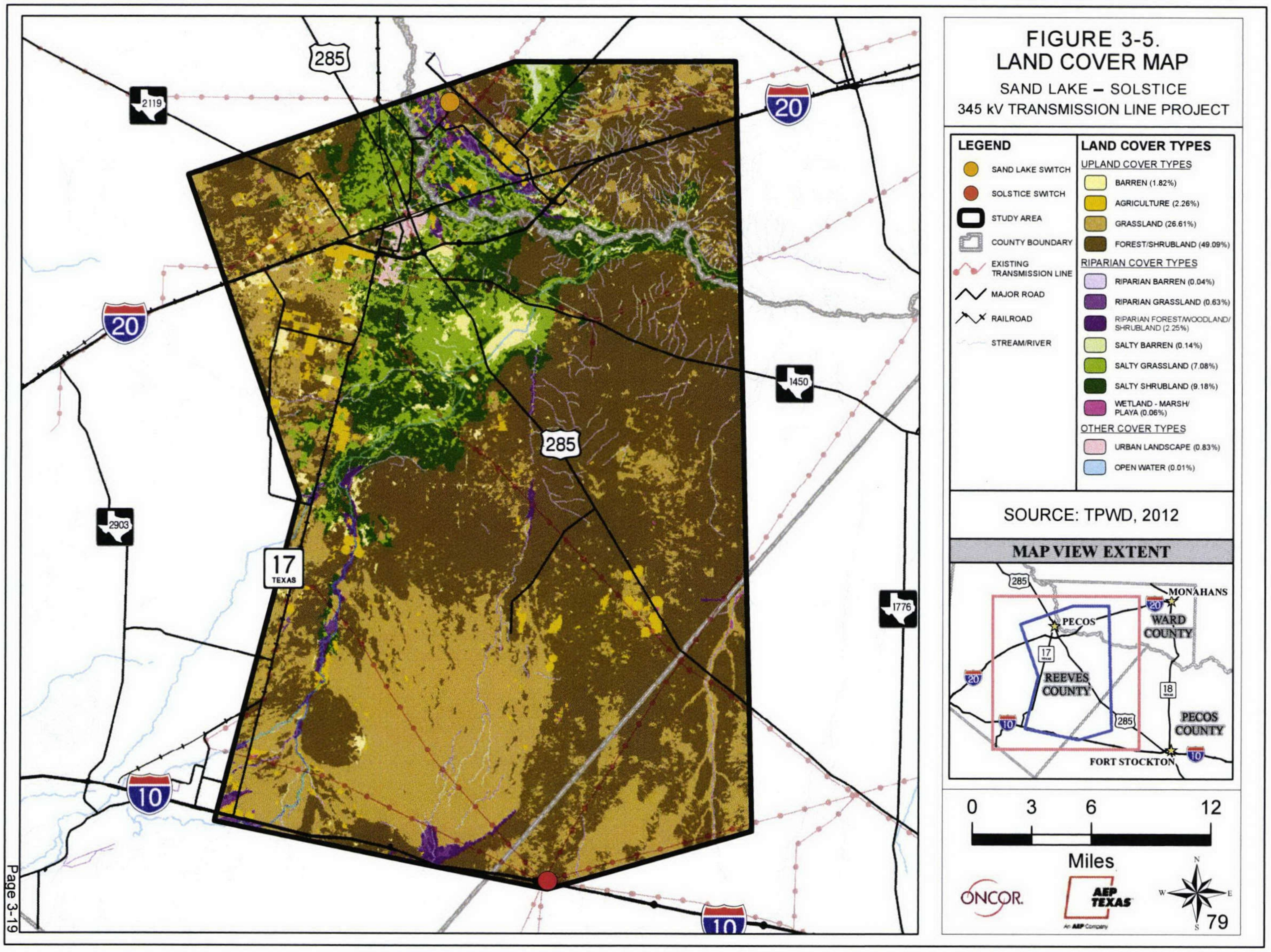

FIGURE 3-5.
LAND COVER MAP
SAND LAKE – SOLSTICE
345 kV TRANSMISSION LINE PROJECT
LEGEND
SAND LAKE SWITCH
SOLSTICE SWITCH
STUDY AREA
COUNTY BOUNDARY
EXISTING TRANSMISSION LINE
MAJOR ROAD
RAILROAD
STREAM/RIVER
LAND COVER TYPES
UPLAND COVER TYPES
BARREN (1.82%)
AGRICULTURE (2.26%)
GRASSLAND (26.61%)
FOREST/SHRUBLAND (49.09%)
RIPARIAN COVER TYPES
RIPARIAN BARREN (0.04%)
RIPARIAN GRASSLAND (0.63%)
RIPARIAN FOREST/WOODLAND/ SHRUBLAND (2.25%)
SALTY BARREN (0.14%)
SALTY GRASSLAND (7.08%)
SALTY SHRUBLAND (9.18%)
WETLAND - MARSH/ PLAYA (0.06%)
OTHER COVER TYPES
URBAN LANDSCAPE (0.83%)
OPEN WATER (0.01%)
SOURCE: TPWD, 2012
MAP VIEW EXTENT
MONAHANS
PECOS
WARD COUNTY
REEVES COUNTY
PECOS COUNTY
FORT STOCKTON
0 3 6 12
Miles
285
20
10
17
2119
2903
1450
1776
18
ONCOR
AEP TEXAS

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Trans-Pecos: Loamy Plains Grassland occurs throughout the study area, with heavy concentrations west of Pecos, Texas, on level deep loams of intermountain basins. Typical vegetation found within this cover type includes blue grama, sideoats grama, black grama, tobosa (*Pleuraphis mutica*), burrograss (*Scleropogon brevifolius*), silver bluestem (*Bothriochloa saccharoides*), cane bluestem (*Bothriochloa barbinodis*), and fluffgrass (*Dasyochloa pulchella*). Honey mesquite, creosotebush and tarbush are common invasive species.

Southwest: Tobosa – Mesquite Grassland EMST cover type predominately and most notably occurs within the southwest region of the study area and along a ravine in the southeast portions. This cover type typically occurs in local topographic lows, often associated with drainages or swales. Soils are generally clayey with some representing shrink-swell characteristics, which may limit the development of woody species in the area. Tobosa is typically the clear dominant species present, often with a significant canopy coverage from honey mesquite. Grass species, such as alkali sacaton and western wheatgrass (*Pascopyrum smithii*), may be present.

Southwest: Tobosa Grassland is intermixed with the Southwest: Tobosa – Mesquite Grassland EMST cover type, in the same drainages and basins located in the southern region of the study area. This cover type is associated with swales and low basins with tight soils where honey mesquite forms a significant canopy over a grassland dominated by tobosa.

The Trans-Pecos: Sandy Desert Grassland EMST cover type is predominantly present in the northeastern region of the study area and alone comprises the Sandy Grassland cover type. This EMST cover type occurs on level plains and gently rolling slopes with sandy soils within the Trans-Pecos and the southern portions of the High Plains. Common grasses found within this EMST include black grama, mesa dropseed, sand dropseed (*Sporobolus cryptandrus*), sand muhly (*Muhlenbergia arenicola*), alkali sacaton, common sandbur (*Cenchrus spinifex*), and purple threeawn (*Aristida purpurea*). Woody vegetation includes honey mesquite, soaptree yucca (*Yucca elata*), plains yucca (*Yucca campestris*), Torrey's yucca (*Yucca torreyi*), and creosotebush.

The Trans-Pecos: Hill and Foothill Grassland EMST cover type sparsely occurs in the southern portion of the study area on rocky soils on broad sloping alluvial areas. Typical vegetation includes black grama, sideoats grama, curly leaf muhly (*Muhlenbergia setifolia*), chino grama (*Bouteloua ramose*), bush muhly (*Muhlenbergia porteri*), six-weeks grama (*Bouteloua barbata*), fluffgrass, Arizona cottontop (*Digitaria californica*), and threeawn (*Aristida* spp.).

Upland shrubland is the most dominant land cover type within the study area, further classified as upland shrubland and sandy shrubland. These cover types are composed of nine EMST cover types (in order of prevalence):

1. Native Invasive: Mesquite-Creosotebush Shrubland;
2. Trans-Pecos: Creosotebush Scrub;
3. Trans-Pecos: Sparse Creosotebush Scrub;
4. Native-Invasive: Mesquite Shrubland;
5. Trans-Pecos: Mixed Desert Shrubland;
6. Non-native Invasive: Saltcedar Shrubland;
7. Native Invasive: Juniper Shrubland;
8. Trans-Pecos: Desert Deep Sand and Dune Shrubland; and
9. Trans-Pecos: Succulent Desert Scrub.

The Native Invasive: Mesquite-Creosotebush Shrubland EMST cover type is scattered throughout the study area. This area is dominated by invasive shrublands of honey mesquite and creosotebush. Tarbush, mariola (*Parthenium incanum*), whitethorn acacia (*Vachellia constricta*), and four-wing saltbush are also common species within this cover type.

The Trans-Pecos: Creosotebush Scrub and Trans-Pecos: Sparse Creosotebush Scrub EMSTs are also common throughout the study area, particularly along terraces or flats and along roadways. These types are mapped at low elevations within intermountain basins in the Trans-Pecos, mainly on flats or gently rolling landscapes over gravelly colluvial or alluvial soils. Creosotebush is often the primary dominant species, often leading to the exclusion of other species.

The Native-Invasive: Mesquite Shrubland EMST cover type is predominately located in the northeastern extent of the study area, intermixed with upland grassland cover types. This area is often dominated by honey mesquite. Other important species include huisache (*Acacia farnesiana*), sugar hackberry (*Celtis laevigata*), ashe juniper (*Juniperus ashei*), cedar elm (*Ulmus crassifolia*), lotebush (*Ziziphus obtusifolia*), agarita (*Mahonia trifoliolata*), winged elm (*Ulmus alata*), sumac (*Rhus* spp.), brasil (*Condalia hookeri*), common persimmon (*Diospyros virginiana*), Texas persimmon (*Diospyros texana*), desert hackberry (*Celtis ehrenbergiana*), and Lindheimer pricklypear (*Opuntia engelmannii* var. *lindheimeri*). A sparse canopy may occur with plateau live oak (*Quercus fusiformis*), coastal live oak (*Quercus virginiana*), and post oak (*Quercus stellata*).

The Trans-Pecos: Mixed Desert Shrubland EMST cover type occurs within the northeastern extent of the study area, on moderate slopes, usually in hills and low mountains rather than alluvial or colluvial desert basins. Shrub diversity is often relatively high, and common components include mariola, creosotebush, whitethorn acacia, skeleton-leaf golden eye (*Viguiera stenoloba*), honey mesquite, catclaw acacia, Torrey's yucca, lechuguilla (*Agave lechuguilla)*, sotol (*Dasylirion* spp.), and ocotillo (*Fouquieria splendens*). The herbaceous layer may include black grama, mesa dropseed, sand dropseed, sand muhly, alkali sacaton, common sandbur, and purple threeawn.

The Non-Native Invasive: Saltcedar Shrubland EMST cover type is found in scattered patches along the Toyah Creek. This cover type is often dominated by saltcedar, yet shrubby sumpweed (*Iva frutescens*), baccharis (*Baccharis* spp.), honey mesquite, huisache, sugar hackberry, and sea ox-eye daisy (*Borrichia frutescens*) may also be present.

The Native Invasive: Juniper Shrubland EMST cover type is encompassed within upland grassland cover types in the southern region of the study area. This shrubland cover type is classified by the dominance of juniper (*Juniperus* spp.).

Trans-Pecos: Desert Deep Sand and Dune Shrubland cover type is locally scattered in the northeastern region of the study area on dry slopes with significant exposed rock comprised of limestone or gravel. This system includes shrubby sites on coppice dunes associated with aeolian sands in the region, often the result of grassland degradation of the Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub land cover type. Vegetative cover is relatively sparse, leaving rock frequently bare. Common shrub species include honey mesquite, sand sage, soaptree yucca, tree cholla (*Cylindropuntia imbricata),* four-wing saltbush, and mormon-tea (*Ephedra* spp.).

The Trans-Pecos: Succulent Desert Scrub EMST cover type is mapped at low elevations on relatively steep slopes. Shrub, succulent, and grass diversity is often high. Succulents may include species such as Torrey's yucca, Texas sotol (*Dasylirion texanum*) and lechuguilla. Common shrubs include ocotillo, creosotebush, mariola, whitethorn acacia, leatherstem (*Jatropha dioica*), skeleton-leaf goldeneye, and honey mesquite. Grasses may include black grama, sideoats grama, slim tridens (*Tridens muticus*), and threeawns. This cover type is uncommon within the study area, and occurs in isolated patches in upland areas.

Riparian cover types within the study area are found associated with the Pecos River and Toyah Creek floodplains and the larger tributary components. As seen on **Figure 3-5**, the riparian cover types are further divided into riparian and salty subtypes. The riparian subtype is predominantly associated with the numerous streams that drain into the Pecos River, while the salty subtype is most prominently associated with the floodplain valley of the Pecos River and Toyah Creek.

The riparian barren cover type consists of the Trans-Pecos: Desert Wash Barren EMST cover type. This cover type is mapped in sparsely vegetated areas along arroyos and draws at relatively low elevations in the Trans-Pecos. The salty barren classification is associated with the Trans-Pecos: Gyp Barrens EMST cover type. This cover type is represented by essentially barren areas over gyp-influenced soils. Sparse cover of gyp-tolerant shrubs and grasses is usually present.

Riparian grasslands are the next dominant cover type within the study area and include three EMST cover types (in order of prevalence):

1. Trans-Pecos: Salty Desert Grassland;
2. Trans-Pecos: Desert Wash Grassland; and
3. Trans-Pecos: Gyp Grassland.

Trans-Pecos: Salty Desert Grassland is one of two salty grassland EMST cover types encompassed within the study area. It is prevalent throughout the Toyah Creek and Pecos River floodplains. This cover type includes saline sites with a sparse or absent shrub canopy cover. Vegetation is predominantly from graminoid species, such alkali sacaton, giant sacaton, saltgrass (*Distichlis spicata*), false Rhodes grass (*Trichloris crinita*), pink pappusgrass (*Pappophorum bicolor*), tobosa, and burrograss.

The Trans-Pecos: Desert Wash Grassland EMST cover type is mapped along relatively low elevation arroyos and draws. Common grasses include sideoats grama, silver bluestem, black grama, and threeawn species. Some areas may be well-watered and salty, and support species such as saltgrass and alkali sacaton. Common shrubs include honey mesquite, creosotebush, desert willow, little walnut (*Juglans microcarpa*), and *Acacia* species.

Trans-Pecos: Gyp Grassland is the other salty grassland EMST cover type included among the riparian grasslands within the study area, occurring over gyp sites on alluvium basins and drainages. The herbaceous layer is present with species, such as gypgrass (*Sporobolus nealleyi*), gyp grama, hairy crinklemat (*Tiquilia hispidissima*), sand nama (*Nama carnosum*), threadleaf glowwort (*Sartwellia flaveriae*), onion blanket-flower (*Gaillardia multiceps*), ringstems (*Anulocaulis* spp.), moonpods (*Selinocarpus* spp.). Other species present may include four-wing saltbush, Torrey jointfir (*Ephedra torreyana*), Hartweg evening primrose (*Calylophus hartwegii*), hoary rosemary-mint (*Poliomintha incana*), Torrey's yucca, alkali sacaton, javelina bush (*Condalia ericoides*), and sand dropseed. This cover type includes a sparse shrub layer, which may include honey mesquite and creosotebush.

Riparian shrublands and woodlands includes five EMST cover types (in order of prevalence):

1. Trans-Pecos: Salty Desert Scrub;
2. Trans-Pecos: Desert Wash Shrubland;
3. Trans-Pecos: Gyp Shrubland;
4. Trans-Pecos: Desert Wash Evergreen Shrubland; and
5. Trans-Pecos: Riparian Woodland.

The Trans-Pecos: Salty Desert Scrub EMST cover type is one of two classified as salty shrubland within the study area. This cover type is spread throughout the Pecos River and Toyah Creek floodplains and surrounding the City of Pecos. It is found over saline basins, salty bottomlands, and alluvial fans with significant shrub cover, including four-wing saltbush, pickle-weed (*Allenrolfea occidentalis*), desert seepweed (*Suaeda suffrutescens*), Christmas cactus (*Cylindropuntia leptocaulis*), honey mesquite, southern Jimmy-weed (*Isocoma pluriflora*), winged sea purslane (*Sesuvium verrucosum*), tarbush, and lotebush.

The Trans-Pecos: Desert Wash Shrubland is mapped along relatively low elevation arroyos and draws. A variety of water regimes are represented, and hence a variety of shrubland types. Common shrubs and small trees include honey mesquite, creosotebush, littleleaf sumac (*Rhus microphylla*), little walnut, ocotillo, desert willow, netleaf hackberry (*Celtis reticulata*), whitethorn acacia, and junipers. Torrey's yucca, sotol, and Christmas cactus are common succulents. Sideoats grama, alkali sacaton, streambed bristlegrass (*Setaria leucopila*), silver bluestem, and tobosa are common grasses.

The Trans-Pecos: Gyp Shrubland is the other salty grassland cover type and is mapped over gyp-influenced soils, usually at relatively low elevations. Important shrubs may include honey mesquite, four-wing saltbush, Torrey jointfir, creosotebush, burrobush (*Ambrosia dumosa*), Torrey's yucca, and javelina bush. Other common species include gyp dropseed (*Sporobolus nealleyi*), gyp grama, hairy crinklemat, bristly nama (*Nama hispidum*), threadleaf glowwort, and onion blanket-flower.

Trans-Pecos: Desert Wash Evergreen Shrubland occurs on intermittently flooded and dry washes or arroyos on plains and basins in the study area. This cover type is often found in desert drainages with evergreen shrub cover, with species such as redberry juniper (*Juniperus pinchotii*).

The Trans-Pecos: Riparian Woodland EMST cover type is mapped along small upland drainages. Common species include netleaf hackberry, honey mesquite, western soapberry (*Sapindus saponaria*), black willow (*Salix nigra*), saltcedar, desert willow, *Baccharis* genera, and Apache plume (*Fallugia paradoxa*).

Whereas several marsh/playa EMST cover types are mapped and included in the larger Wetland – Marsh/Playa subset, the coverage of these small, scattered habitats is difficult to discern on **Figure 3-5**. The Trans-Pecos: Marsh EMST cover type is a generic type that was assigned to marsh where soils were not considered naturally moist. A variety of moist areas, including constructed stock tanks that are alternately wet and dry, are included. Common dominants include spikerushes (*Eleocharis* spp.), cattails (*Typha* spp.), Bermuda grass (*Cynodon dactylon*), and smartweeds (*Polygonum* spp.). This cover type is identified within a few drainages. The Non-Native Invasive: Giant Reed EMST cover type consists of essentially monotypic stands of giant reed (*Arundo donax*) and is mapped on floodplain soils of the Pecos River. Stands usually occur immediately adjacent to the river and may extend away from the river to cover moist floodplain soils along some section of the river. A few scattered areas of this cover type have been mapped in various areas along other unnamed tributaries within the study area. The Trans-Pecos: Desert Playa Grassland EMST is found scattered around drainages of the Pecos River. This EMST cover type occurs on areas that alternate between wet and dry areas, which drains internally on clay-lined basins. Species located within this cover type include saltgrass, pickle-weed, woody crinklemat (*Tiquilia canescens*), sea-blite (*Suaeda* spp.), Russian thistle (*Salsola* spp.), and four-wing saltbush. Lastly, the Trans-Pecos: Desert Ciénega Marsh type is often found in drainages fed by ciénegas (wetland system unique to the American Southwest, often fed by springs or seeps). Different water regimes cause zonation in some of the larger ciénegas, with wetter areas dominated by bulrush, and drier areas dominated by saltgrass and alkali sacaton. Other common species include giant sacaton, alkali muhly (*Muhlenbergia asperifolia*), desert horse purslane (*Trianthema portulacastrum*), and desert seepweed. Honey mesquite, four-wing saltbush, and saltcedar are also common woody components. This cover type is identified in two, small areas: one along a riparian zone in the southern range of the study area and the other in a riparian area just east of the City of Pecos.

A list of plant species commonly found in upland areas throughout the various cover types in the study area is presented in **Table 3-2**.

TABLE 3-2. UPLAND PLANT SPECIES IN THE STUDY AREA.

Common Name	Scientific Name	Common Name	Scientific Name
Grasses		**Major Associated Woody Plants (continued)**	
Alkali muhly	*Muhlenbergia asperifolia*	Honey mesquite	*Prosopis glandulosa*
Alkali sacaton	*Sporobolus airoides*	Huisache	*Acacia farnesiana*
Arizona cottontop	*Digitaria californica*	Javelina bush	*Condalia ericoides*
Bermuda grass	*Cynodon dactylon*	Juniper	*Juniperus* spp
Black grama	*Bouteloua eriopoda*	Little walnut	*Juglans microcarpa*
Blue grama	*Bouteloua gracilis*	Littleleaf sumac	*Rhus microphylla*
Burrograss	*Scleropogon brevifolius*	Lotebush	*Ziziphus obtusifolia*
Bush muhly	*Muhlenbergia porteri*	Mariola	*Parthenium incanum*
Cane bluestem	*Bothriochloa barbinodis*	Mormon-tea	*Ephedra* spp.
Chino grama	*Bouteloua ramose*	Netleaf hackberry	*Celtis reticulata*
Common reed	*Phragmites australis*	Ocotillo	*Fouquieria splendens*
Common sandbur	*Cenchrus spinifex*	Plateau live oak	*Quercus fusiformis*
Curly leaf muhly	*Muhlenbergia setifolia*	Post oak	*Quercus stellata*
False Rhodes grass	*Trichloris crinita*	Redberry juniper	*Juniperus pinchotii*
Fluffgrass	*Dasyochloa pulchella*	Saltcedar	*Tamarix* spp
Giant dropseed	*Sporobolus giganteus*	Sand sagebrush	*Artemisia filifolia*
Giant reed	*Arundo donax*	Skeleton-leaf golden eye	*Viguiera stenoloba*
Giant sacaton	*Sporobolus wrightii*	Sugar hackberry	*Celtis laevigata*
Gyp dropseed	*Sporobolus nealleyi*	Sumac	*Rhus* spp.
Gyp grama	*Bouteloua breviseta*	Tarbush	*Flourensia cernua*
Gypgrass	*Sporobolus nealleyi*	Texas persimmon	*Diospyros texana*
Mesa dropseed	*Sporobolus flexuosus*	Western soapberry	*Sapindus saponaria*
Pink pappusgrass	*Pappophorum bicolor*	Whitethorn acacia	*Vachellia constricta*
Purple threeawn	*Aristida purpurea*	Winged elm	*Ulmus alata*
Saltgrass	*Distichlis spicata*	**Representative Associated Forbs**	
Sand dropseed	*Sporobolus cryptandrus*	Bristly nama	*Nama hispidum*
Sand muhly	*Muhlenbergia arenicola*	Cattail	*Typha* spp.
Sand nama	*Nama carnosum*	Desert seepweed	*Suaeda suffrutescens*
Sideoats grama	*Bouteloua curtipendula*	Hairy crinklemat	*Tiquilia hispidissima*
Silver bluestem	*Bothriochloa saccharoides*	Hartweg evening primrose	*Calylophus hartwegii*
Six-weeks grama	*Bouteloua barbata*	Hoary rosemary-mint	*Poliomintha incana*
Slim tridens	*Tridens muticus*	Moonpods	*Selinocarpus* spp.
Streambed bristlegrass	*Setaria leucopila*	Onion blanket-flower	*Gaillardia multiceps*
Tobosa	*Pleuraphis mutica*	Pickle-weed	*Allenrolfea occidentalis*
Threeawn	*Aristida* spp	Ringstems	*Anulocaulis* spp
Western wheatgrass	*Pascopyrum smithii*	Russian thistle	*Salsola* spp
Major Associated Woody Plants		Sea-blite	*Suaeda* spp
Apache plume	*Fallugia paradoxa*	Sea ox-eye daisy	*Borrichia frutescens*
Agarita	*Mahonia trifoliolata*	Shrubby sumpweed	*Iva frutescens*
Ashe juniper	*Juniperus ashei*	Smartweed	*Polygonum* spp.
Baccharis	*Baccharis* spp	Southern Jimmy-weed	*Isocoma pluriflora*
Blackbrush	*Vachellia rigidula*	Spikerush	*Eleocharis* spp
Black willow	*Salix nigra*	Threadleaf glowwort	*Sartwellia flaveriae*
Brasil	*Condalia hookeri*	Torrey's jointfir	*Ephedra torreyana*
Brickellbush	*Brickellia* spp	Winged sea purslane	*Sesuvium verrucosum*
Burrobush	*Ambrosia dumosa*	Woody crinklemat	*Tiquilia canescens*
Catclaw acacia	*Senegalia greggii*	**Representative Associated Succulents**	
Cedar elm	*Ulmus crassifolia*	Christmas cactus	*Cylindropuntia leptocaulis*
Coastal live oak	*Quercus virginiana*	Desert horse purslane	*Trianthema portulacastrum*
Common persimmon	*Diospyros virginiana*	Leatherstem	*Jatropha dioica*
Creosotebush	*Larrea tridentata*	Lechuguilla	*Agave lechuguilla*
Desert hackberry	*Celtis ehrenbergiana*	Lindheimer pricklypear	*Opuntia engelmannii var. lindheimeri*
Desert willow	*Chilopsis linearis*	Plains yucca	*Yucca campestris*

TABLE 3-2. UPLAND PLANT SPECIES IN THE STUDY AREA.

Common Name	Scientific Name	Common Name	Scientific Name
Representative Associated Succulents (cont'd)		Pricklypear	*Opuntia spp.*
Four-wing saltbush	*Atriplex canescens*		
Soaptree yucca	*Yucca elata*		
Sotol	*Dasylirion* spp.		
Tree cholla	*Cylindropuntia imbricata*		
Torrey's yucca	*Yucca torreyi*		
Texas sotol	*Dasylirion texanum*		
Yuca species	*Yucca* spp.		
Sources· Griffith et al., 2007; NRCS, 2006; TPWD, 1984; TPWD, 2007; TPWD, 2012; and field observations in September 2018			

The bulk of the region is used for oil and gas production or range for livestock; cropland within the study area is less common and is limited to scattered irrigated fields. The cropland in the area is used primarily for hay and cotton (NRCS, 2018; SCS, 1975–1980; TPWD, 2012; USDA, 2012). A variety of grasses, forbs (non-grass herbaceous plants), and woody species pervade unimproved rangeland pastures and roadside areas. As previously noted, unmanaged, grass-dominated areas (in the absence of fire) eventually become upland shrubland areas. These shrubland areas continue to provide rangeland pasture for livestock, although of decreasing forage quality and quantity. Without periodic mechanical removal, herbicide treatment, or prescribed burning to control woody plants, grass-dominated areas eventually develop into shrubland.

3.5.1.2 Aquatic/Hydric Vegetation

The hydric habitats in the study area are limited, and are generally adjacent to impoundments, depressions, stream channels, and the Pecos River and its tributaries. Much of the surface water in this part of the Trans-Pecos and High Plains occurs in seasonal playa lakes that form in small depressions. Ciénegas are also present, which are small, isolated, spring-fed wetlands in the desert basins. Impoundments generally result in either permanent, intermittent, or ephemeral freshwater flat wetlands, marshes, or fringe marshes. Vegetation in aquatic habitats would typically be limited to the shallow edges of the water. Plant species common to this habitat type include rushes (*Juncus* spp.), sedges (*Carex* spp.), cattail, flatsedges (*Cyperus* spp.), smartweeds, and spikerushes.

To identify areas that may potentially contain wetland habitats, National Wetlands Inventory (NWI) maps (on 1:24,000 scale topographic base maps) were examined. These maps highlight areas where potential jurisdictional wetland features may be found, based on aerial photography, and ground topography (USFWS, 1994). The NWI maps indicate that wetland areas that range in size and classification consist of several different types and are scattered throughout the study area. Many areas of riverine and scrub-shrub wetlands are located along the Pecos River and the Toyah Creek floodplains and within the north central portion of the study area. Numerous small ponds and scrub-shrub and emergent wetlands are associated with the streams that drain into the Pecos River. A few wetland features are located within naturally occurring depressions. These features vary in terms of the flooding regime and salinity. Livestock watering ponds are also frequently mapped water features on the NWI maps, many of which would likely not be considered jurisdictional (i.e., those wetland areas subject to USACE regulations) under current USACE regulations. Otherwise, the other hydric areas in the study area may be jurisdictional wetlands, if they are associated with streams that have a surface connection to relatively permanent waters that connect with navigable waters.

3.5.1.3 Commercially or Recreationally Important Vegetation

Commercially important crops are typically irrigated in the area. The salinity of the soils is another limiting factor for agricultural production. Rangeland for livestock is the most widespread use of agricultural land throughout the study area, in terms of the number of acres. Since average annual rainfall is 12 inches, grass production is normally sparse. The native grassland in the region has been grazed for several generations. As a result, a high percentage of the more desirable grass and forbs for livestock have been grazed out. This has permitted less desirable grasses, weeds, and brush to invade.

Habitat, rather than any plant species, may be important for recreational hunting in the study area. Birds and mammals that prefer open habitat make use of the croplands and abundant rangeland throughout the study area. Waterfowl may make use of playa lakes and wetlands in the area.

3.5.1.4 Endangered and Threatened Plant Species

TPWD maintains the Natural Diversity Database (NDD) to track known occurrences of threatened, endangered, and otherwise rare plant and animal species throughout Texas. TPWD's NDD provides information about the locations and descriptions of rare habitats and areas managed to achieve high species diversity, as well as provide quality habitat for common and rare wildlife species. Typically, information obtained from the NDD includes a descriptive record with Element Occurrence Identification (EOID) numbers corresponding with mapped locations of all rare habitats within the study area. TPWD and USFWS lists of endangered and threatened species for Reeves, Ward, and Pecos counties were also reviewed (TPWD, 2018b; 2018c). Maps and data received from the NDD in May 2018 indicated there are recorded observations of two state or federally listed plant species within the study area (TPWD, 2018b). It is important to note that, because the NDD is based on the best data available to TPWD regarding rare species, these data cannot provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in any area. Given the small proportion of public versus private land in Texas, the NDD does not include a representative inventory of rare resources in the state. Also, the data is not complete, as there are gaps in coverage due to the lack of access to land or data and a lack of staff and resources to collect and process data on all rare and significant resources.

The first of the two listed plant species, the Pecos, or puzzle, sunflower (*Helianthus paradoxus*) historically found in Reeves County, is listed with a federal status designation of Federally Listed Threatened Species (LT), meaning a final ruling has been published in the Federal Register to list the species as threatened (USFWS, 2018a). A critical habitat area has been established for the species by the USFWS approximately 16 miles southeast of the study area. Known from drainages in New Mexico and West Texas, including the Pecos River, the Pecos sunflower is restricted to saline, calcareous, heavy-textured soils around ciénegas. It is usually most abundant on perennially wet soils of sub-irrigated terraces just above the wettest sites (TPWD, 2018c). Although the Pecos sunflower grows in saline soils, its seeds germinate and establish best when the water table is high, reducing salinity near the soil surface. Due to its dependency on ciénega habitats, over-pumping of groundwater is a threat to the Pecos sunflower. Within the historic range of Pecos sunflower in Texas (i.e., Pecos and Reeves counties), only 13 of 61 springs are still flowing (Poole et al., 2007). There is one known occurrence of the Pecos sunflower within the study area recorded in 1970. The observation was made in the general vicinity of a salt lake beginning 3 miles southeast of the City of Pecos. This observation is well outside of the federally established critical habitat area. While outside of the critical habitat area, the presence of the suitable saline/calcareous soils and habitat support the potential presence of the Pecos sunflower in a limited capacity within the study area.

Lloyd's Mariposa cactus (*Echinomastus mariposensis*) is the other plant species listed by the USFWS to possibly occur within the study area. This species is also listed with a federal threatened status designation; however, no critical habitat has been established. Lloyd's Mariposa cactus was highly sought after historically as a rare ornamental cactus by collectors, leading to a drastic decline in the population of the species. Typical occurrences of Lloyd's Mariposa cactus have been observed near the southwestern borders of Reeves and Pecos counties around the Boquillas geologic formation in small, isolated communities in desert shrublands on gentle, gravelly/rocky limestone slopes with limestone-derived soils (TPWD, 2018c). While portions of the Boquillas geologic formation make up only 0.18% of the total land area of Reeves and Pecos counties, and it is located well outside of the study area, the presence of many limestone-derived soils on rocky, gentle slopes across Reeves and Pecos counties make the occurrence of the species plausible in sporadic, isolated communities in the study area.

Through the Texas Conservation Action Plan, TPWD strives to keep "species of greatest conservation need" (SGCN), whether terrestrial, freshwater, or marine species, including birds, mammals, reptiles, amphibians, invertebrates, fish, plants, and plant communities. Species that are uncommon or exhibit declining numbers may be designated as SGCN by TPWD. Often these designations are placed on species for which little is known as a precautionary measure and to focus attention on gaining insight into the species' life histories before they become rare. The goal for the Texas Conservation Action Plan is to identify and classify species as SGCN to develop a plan to prevent future listings under the Endangered Species Act (ESA). This designation indicates the agency's awareness of the species but does not signify a regulatory status (TPWD, 2012). Data from the TPWD county lists indicate that the following species shown in **Table 3-3** are known to occur in Pecos, Reeves, and Ward counties (TPWD, 2018c).

TABLE 3-3. ENDANGERED, THREATENED, OR RARE PLANTS.

Common Name	Scientific Name	Listing Status[1, 2]		Species Likely to Occur within Study Area
		Federal	State	
Alkali spurge	*Chamaesyce astyla*	--	SGCN	Yes
Bigelow's desert grass	*Blepharidachne bigelovii*	--	SGCN	Yes
Broadpod twistflower	*Streptanthus platycarpus*	--	SGCN	Yes
Bushy wild-buckwheat	*Eriogonum suffruticosum*	--	SGCN	Yes
Cienega false clappia-bush	*Pseudoclappia arenaria*	--	SGCN	Yes
Correll's green pitaya	*Echinocereus viridiflorus* var *correllii*	--	SGCN	Yes
Cory's ephedra	*Ephedra coryi*	--	SGCN	Yes
Desert night-blooming cereus	*Peniocereus greggii* var. *greggii*	--	SGCN	Yes
Dune umbrella-sedge	*Cyperus onerosus*	--	SGCN	Yes
Dwarf broomspurge	*Chamaesyce jejuna*	--	SGCN	Yes
Grayleaf rock-daisy	*Perityle cinereal*	--	SGCN	Yes
Gyp locoweed	*Astragalus gypsodes*	--	SGCN	Yes
Havard trumpets	*Acleisanthes acutifolia*	--	SGCN	Yes
Hawksworth's mistletoe	*Phoradendron hawksworthii*	--	SGCN	Yes
Hester's cory cactus	*Escobaria hesteri*	--	SGCN	No
Hinckley's spreadwing	*Eurytaenia hinckleyi*	--	SGCN	Yes
Irion County wild-buckwheat	*Eriogonum nealleyi*	--	SGCN	Yes
Leafy rock-daisy	*Perityle rupestris* var *rupestris*	--	SGCN	No
Leoncita false foxglove	*Agalinis calycina*	--	SGCN	Yes
Lloyd's Mariposa cactus	*Echinomastus mariposensis*	LT	T	Yes
Longstalk heimia	*Nesaea longipes*	--	SGCN	Yes
McVaugh's bladderpod	*Physaria mcvaughiana*	--	SGCN	No
Pecos/Puzzle sunflower	*Helianthus paradoxus*	LT	T	Yes
Rayless rock-daisy	*Perityle angustifolia*	--	SGCN	Yes
Tharp's blue-star	*Amsonia tharpii*	--	SGCN	No
Two-bristle rock-daisy	*Perityle bisetosa* var *bisetosa*	--	SGCN	No
Warnock's water-willow	*Justicia warnockii*	--	SGCN	Yes
White column cactus	*Escobaria albicolumnaria*	--	SGCN	Yes
Wright's beardtongue	*Penstemon wrightii*	--	SGCN	No
Wright's trumpets	*Acleisanthes wrightii*	--	SGCN	Yes
Wright's water-willow	*Justicia wrightii*	--	SGCN	No

Sources: USFWS, 2018a, USFWS, 2018b; TPWD, 2018b; TPWD, 2018c.
Notes.
[1] TPWD listing codes: T = State Listed Threatened Species and SGCN = Species of Greatest Conservation Need (i.e., rare species with no regulatory listing status).
[2] USFWS listing codes: LT = Federally Listed Threatened Species

Alkali spurge is a low perennial herb found most frequently in nearly barren areas with alkaline/saline silt loam soils on alluvial flats. Soil associations meeting this criteria and large alluvial flats are frequent throughout Reeves and Pecos county, with documented NDD records of the species occurring around Diamond Y Springs Preserve (TPWD, 2018b; 2018c). While only two observations were recorded in a limited area in previous studies, it is probable this species could exist in the study area due to the presence of suitable habitat.

Bigelow's desert grass is an inconspicuous perennial species of desert flats, mesas, and limestone hills in the Trans-Pecos region. This grass is restricted to xeric limestone or various gypsum-influenced habitats. Bigelow's desert grass flowers March to December, and fruits March to December (TPWD, 2018c). This plant is documented in NDD records in Pecos County, approximately 35 miles southeast of the study area (TPWD, 2018b). The presence of suitable soils and habitats suggests this species may occur within the study area.

The Broadpod twistflower occurs sparingly in various habitats within the Western Edwards Plateau, the Trans-Pecos, and the Llano Uplift. This biennial annual mustard flowers and fruits between March and June (TPWD, 2018c). The NDD database denotes one observation of the broadpod twistflower 67 miles east of the study area (TPWD, 2018b). As the species is listed as occurring sparingly in a variety of different habitats, the broadpod twistflower may occur in small communities throughout the study area.

Bushy wild-buckwheat is a Texas endemic found sparsely vegetated on rocky limestone slopes, low hills, and clay flats. It may also occur on gypseous soils. This species flowers from March through April and full fruit is present in May (TPWD, 2018c). The NDD database documents the busy wild-buckwheat nearly 18 miles southeast of the study area (TPWD, 2018b). The bushy wild-buckwheat may be found wherever suitable habitat is present.

The Cienega false clappia-bush is found in mostly alkali sacaton grasslands on alkaline, gypseous, or saline soils of alluvial flats around ciénegas, playa lakes, and other desert wetlands. This perennial bush flowers spring and summer (TPWD, 2018c). This plant is documented in NDD records in Reeves County, near to the City of Pecos, within the study area (TPWD, 2018b). It is likely for the Cienega false clappia-bush to be found wherever suitable habitat is present.

Correll's green pitaya is a Texas endemic found among grasses growing within rock crevices on low hills in desert or semi-desert grassland on novaculite or limestone. This species flowers from March to May (TPWD, 2018c). This species is documented within the NDD database 13 miles east of the southeast corner of the study area (TPWD, 2018b). Correll's green pitaya may be present wherever suitable habitat exists.

Cory's ephedra is a rare species found on dune areas and dry grasslands in the peripheral Trans-Pecos region. This perennial shrub flowers April to September and fruits May to September. Cory's ephedra is primarily located on the rocky hills of the Edwards Plateau or sandy areas and grasslands of the south plains (NatureServe Explorer, 2018; TPWD, 2018c). With a wide range of habitat for this region of Texas, there is potential that Cory's ephedra may be present wherever suitable habitat exists.

The desert night-blooming cereus inhabits Chihuahuan Desert shrublands or shrub invaded grasslands in alluvial or gravelly soils at lower elevations (3,900-4,900 feet), on slopes, benches, arroyos, flats, and washes. The flowering of this species is synchronized over a few nights in early May to late June when almost all mature plants bloom. The flowers last only one day and open just after dark. This cactus may flower as early as April. The shrublands and grasslands with alluvial or gravelly soils within the study area could provide habitat for the desert night-blooming cereus (TPWD, 2018c). The NDD database documents two locations for this species in the southern edge of Reeves County, with the nearest being less than 5 miles from the southwest corner of the study area (TPWD, 2018b). There is potential for the desert night-blooming cereus to be found within the study area wherever suitable habitat is available.

The dune umbrella sedge is found in moist to wet sand in swales and other depressions among active or partially stabilized sand dunes. This sedge flowers and fruits late summer to fall (TPWD, 2018c). The plant is documented three times within the NDD records, both in Winkler and Ward counties approximately 13 miles northeast of the study area (TPWD, 2018b). The dune umbrella sedge may be found in marginal dune habitat in the study area.

Dwarf broomspurge is found in grama-grass dominated prairies on caliche uplands, dry caliche slopes, and limestone hills. This species flowers from late March through July (TPWD, 2018c). The NDD database includes one record for dwarf broomspurge 17 miles east of the study area boundary in Pecos County (TPWD, 2018b). It is likely for dwarf broomspurge to be present wherever suitable habitat is available.

The grayleaf rock-daisy is found in crevices in dry limestone caprock of mesas. This Texas endemic flowers spring to fall (TPWD, 2018c). The plant is documented in NDD records in Reeves County, near the City of Pecos and southeast of the study area in Pecos County. However, the records date to 1943 with little information as to the exact location of the record (TPWD, 2018b). There is potential for the grayleaf rock-daisy to be found within the study area wherever suitable habitat may be found.

The gyp locoweed is found on gypsum or stiff gypseous clay soils on low rolling hills, mostly in lower elevations of the middle Pecos River Valley region. Many of the known locations are on the Castile Formation of the Permian Period (TPWD, 2018c). The presence of gypsum surface geology and the study area location within the middle Pecos River Valley region supports that the presence of the gyp locoweed is possible. The plant is documented in NDD records in Reeves County approximately 7 miles northwest of the study area (TPWD, 2018b). There is potential for gyp locoweed to occur within the study area wherever suitable habitat exists.

Havard trumpets is found in xeric limestone or gypseous habitats. This perennial species flowers from July to September (TPWD, 2018c). The NDD database indicates one record of havard trumpets 10 miles southeast of the study area in Pecos County (TPWD, 2018b). Havard trumpets is likely to occur wherever suitable habitat is present.

Hawksworth's mistletoe is found in the mountains of the Trans-Pecos and at lower elevations in the western Edwards Plateau. This perennial species is parasitic on juniper (*Juniperus spp.*) vegetation. Hawksworth's mistletoe flowers and fruits between April and December (TPWD, 2018c). This species may be present within the study area wherever suitable habitat exists.

Hester's cory cactus is found in grasslands on novaculite or limestone hills and alluvial fans or in pine-oak-juniper woodlands on igneous substrates. This Texas endemic species flowers from April to early June, as well as during the growing season possibly in response to significant rainfall. It fruits from June through August (TPWD, 2018c). The NDD database includes records of Hester's cory cactus found in a canyon southeast of the study area in Pecos and Brewster counties (TPWD, 2018b). With the absence of similar habitat, it is unlikely for this species to occur within the study area.

Hinckley's spreadwing is found both in deep sands around active dunes, such as the Monahans and Kermit sandhills, where it is associated with Havard oak shinneries, as well as shallower or more stable sands dominated by mesquite - sand sage shrublands. The shrublands within the sand sheets and sand dunes within the study area could provide habitat for Hinckley's spreadwing (TPWD, 2018c). This species is recorded in NDD in Ward and Winkler counties, east of the study area (TPWD, 2018b). As dune habitats are present within the study area, there is potential for Hinckley's spreadwing to be present within the study area.

Irion County wild-buckwheat occurs in grasslands and on shallow stony soils over limestone and indurated caliche, and it is frequently found on ungrazed and sparsely vegetated roadsides, especially where limestone or caliche is exposed on hilltops. This Texas endemic species is found flowering from June to September (TPWD, 2018c). Irion County wild-buckwheat may occur wherever suitable habitat exists.

The leafy rock-daisy resides in igneous rock outcrops. This perennial plant flowers from May to November and fruits between June and September (TPWD, 2018c). Due to the lack of igneous rock outcrops present within the study area, it is not likely for the leafy rock-daisy to be present.

Leoncita false foxglove occurs in grasslands on perennially moist, heavy, alkaline, or saline, calcareous silty clays and loams in and around ciénegas and seeps. This annual species flowers from September to October (TPWD, 2018c). The NDD database includes two records of Leoncita false foxglove approximately 15 miles east of the study area (TPWD, 2018b). Leoncita false foxglove may be present wherever suitable habitat is available.

Longstalk heimia is associated with moist or subirrigated alkaline or gypsiferous clayey soils along unshaded margins of ciénegas and other wetlands. Sparingly, this species may occur on an alkaline or somewhat saline silt loam on terraces of spring-fed streams and in subirrigated wetlands atop poorly-defined spring systems. It may also be found in low, wetland areas along highway ROW. This species flowers from May to September (TPWD, 2018c). The NDD database includes five records of longstalk heimia along the

IH 10 corridor and near ciénegas habitats (TPWD, 2018b). It may be found wherever suitable habitat exists.

McVaugh's bladderpod is found in grasslands on rocky limestone uplands at moderate elevations ranging from 3,900 to 5,200 feet. It is also associated with stream bed gravels, rocky limestone slopes and hills. This species may be found in canyon bottoms and slopes or in limestone rubble. McVaugh's bladderpod is a perennial that flowers and fruits from March to August (TPWD, 2018c). Four records in the NDD database associate McVaugh's bladderpod in intermontane streams in the Glass Mountains, southeast of the study area (TPWD, 2018b). Due to the low elevation of the study area, it is unlikely that McVaugh's bladderpod is present.

The rayless rock-daisy is found in the crevices of limestone bluffs and cliff-faces. It is a perennial species that flowers from April to October and fruits from April to September (TPWD, 2018c). This species is endemic to Texas on the Edwards Plateau (NatureServe Explorer, 2018). The NDD database includes three records of the rayless rock-daisy occurring within the Glass Mountain range in Pecos County (TPWD, 2018b). This species is likely to occur wherever suitable habitat exists.

Tharp's blue-star is found in open areas in midgrass grasslands or shrublands in shallow clay soils over limestone; very shallow soils; well-drained calcareous moderately alkaline, light brownish-gray stony loam of Lozier-Rock outcrop; or developed over fractured caliche-coated limestone (TPWD, 2018c). This species is known to only one location in Texas in Pecos County and is east of the study area, according to the NDD database (NatureServe Explorer, 2018; TPWD, 2018b). As this species is associated with a specific location outside of the study area, it is unlikely to occur within the study area boundaries.

Two-bristle rock-daisy is a Texas endemic found in crevices of limestone exposures on bluffs and other rock outcrops (TPWD, 2018c). This subspecies is geographically isolated to the Sanderson Canyon and tributaries in southern Pecos County (NatureServe Explorer, 2018). It is unlikely for the two-bristle rock-daisy to be present within the study area, due to its limited geographic distribution.

Warnock's water-willow occurs mostly on xeric limestone uplands and rock outcrops in succulent-dominated shrublands. This perennial species flowers from May to December and fruits in June (NatureServe Explorer, 2018; TPWD, 2018c). The NDD database includes one record of Warnock's water-willow, in the Glass Mountains in Pecos County (TPWD, 2018b). This species may occur wherever suitable habitat exists.

White column cactus is associated with creosotebush or lechuguilla canyon shrublands, primarily on nearly level terrain to rolling hills on thin, gravelly soils or limestone bedrock of the Santa Elena, Glen Rose, Boquillas, and Telephone Canyon formations. It is found at lower elevations of approximately 1,800 to 5,000 feet in the Chihuahuan Desert. This cactus species flowers from early March to May (TPWD, 2018c). The NDD database includes three records of the white column cactus to the southeast of the study area; two found in canyons of the Glass Mountains and the other near mesa habitats in eastern Pecos County (TPWD, 2018b). This species may be present wherever suitable habitat is available.

Wright's beardtongue occurs mostly in montane grasslands and woodlands. This perennial forb flowers April to August and fruits May to August (TPWD, 2018c). The NDD database includes one record of Wright's beardtongue in Reeves County, 10 miles west of the study area. This record includes the historic range, where the last observation dates back from 1943 (TPWD, 2018b). Wright's beardtongue is not likely to occur in the study area, due to lack of montane areas.

Wright's trumpets are a perennial found in open semi-desert grasslands and shrublands on shallow stony soils over limestone on low hills and flats. This forb flowers spring to fall, and probably also in response to rains (TPWD, 2018c). The NDD database includes five records to the southeast and at the southern edge of the study area for Wright's trumpets (TPWD, 2018b). The semi-desert grasslands and shrublands within the areas of limestone geology could provide habitat for Wright's trumpets.

Wright's water-willow is found in shortgrass grasslands and/or shrublands on dry gravelly clay soils over limestone on flats and low hills, at an elevation of 2,900 to 4,900 feet. This species flowers from April to August or after periods of sufficient rainfall (TPWD, 2018c). The NDD database includes three records of Wright's water-willow in Pecos County near